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Brazilian Agriculture – yesterday, today and tomorrow - a case study of an emerging exporter

Draft Discussion Document

30 April 2005

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III. Introduction

Brazil has emerged as a major exporter of agricultural products. This case study provides a context of the growth in Brazil's market share of world production and exports for all major competitors including Canada. Brazil exemplifies an emerging supplier that is rapidly becoming a major player on the world scene and replacing the United States as the agricultural powerhouse. This may not be an equilibrium situation as Brazil has the potential to be an even a larger player on the world scene, with consequences for export competition and prices received by other exporters. This study addresses the major facts and issues surrounding Brazil's rise as a major agricultural exporter. We will answer questions such as:

- Where has Brazil come from?
- What have been the trends and changes in production, exports, and share of global trade?
- Has the expansion in exports been in primary products or in higher valued added products as well?
- How much future supply potential does Brazil have to offer?
- What will Brazil look like in 10 years?
- What issues does Brazil have to manage to continue is expansionary path?
- What are some of the longer-term consequences of a supplier such as Brazil on Canada?
- Are Brazilian regulatory standards regarding crop protection and animal health comparable to Canada's, as they apply to exports?
- What policy initiatives and programs did Brazil use to increase its position in the global market?
- What has been the role of multi-nationals in Brazil's success?
- Has Brazil used the strategy of adopting existing technologies, or are they becoming an innovation leader, using new technologies to solve internal constraints and develop new products, markets, etc.?

In explaining the success of Brazilian agriculture, an important point to consider is that the highly competitive system that characterizes the agribusiness sector in Brazil has been developed in the last 30 years. To emphasize this point, the adaptation of modern varieties, the development of agricultural practices suitable to tropical conditions, the stimulus for the development of several input industries (fertilizers, machinery, tractors and combines, agrochemicals) and the creation of

a national research system were all part of several policies constructed during the 1960's and 70's that were capable of converting poor soil into highly productive areas. In other words, Brazil's geography, climate and natural resources were transformed into an agricultural production powerhouse only through technological development and an institutional environment that promoted investment. Until the mid 1980s, the Center-West, a region with typical vegetation known as "cerrado", was considered to be unsuitable for modern agricultural production. This region now is the most dynamic in terms of growth in the production of agricultural products.

It is important to notice that the agribusiness system in Brazil has become quite complex in terms of the variety of products and food processing capabilities. A wide range of crops (soybeans, sugar, coffee, orange juice, corn and fruit) and livestock products (chicken, swine and red meat) are produced and exported in both its raw and processed form. Until the mid 1990s, Brazil's exports were primarily in bulk form with little processing. This pattern has changed slightly during the last decade, showing potential growth for more value added exports. However, trade barriers in its many forms, especially in developed countries, will limit the speed of this change. The core of this study is to explain this transition, pointing out the strengths, weaknesses and challenges for Brazilian agriculture.

The rest of this study is organized into four sections. The next section presents the end of the story, assessing where Brazil is now in terms of the level of exports and costs of production (that probably are, for many crops and animal production, the lowest in the world). The second section explains the reasons for the success, presenting some of the growth determinants of Brazilian agriculture. The third section emphasizes the acceleration of production and exports in the last decade as a consequence of the macroeconomic stabilization program, known as Plano Real, which was launched in 1994. The last part summarizes the main challenges facing Brazilian agriculture.

IV. The situation today: a case of success

Brazilian agriculture plays an important role on international markets. In a growing variety of markets, Brazilian exports are responsible for a large part of international trade. As can be seen in table 1, Brazil is responsible for 82% of the international orange juice export market, 38% of world soybean exports, 34% of soybean meal trade, and 29% of the sugar, chicken and coffee export markets. In all markets listed in table 1, Brazil has one of the four leading positions in world trade. Note that the annual growth rate of exports in these commodities between 1990 and 2003 are quite high, averaging 14 percent.

Table 1. Brazilian export value and ranking in the world

Product	Export value 2004	Brazil/World (2003)		Annual growth rate
	(mil. US$)	Market sh	Ranking	(1990-2003)
Soybean	5,395	38%	1	17%
Soybean meal	3,271	34%	2	4%
Sugar	2,640	29%	1	18%
Chicken	2,595	29%	2	13%
Beef	2,467	20%	1	9%
Coffee	2,024	29%	1	3%
Tobacco	1,426	23%	1	7%
Soybean oil	1,400	28%	2	9%
Orange juice	790	82%	1	1%
Pork meat	1,091	16%	4	27%
Corn	581	4%	4	53%
Cotton	180	5%	4	12%
Total	**23,860**	**28.0%**	**3**	**14%**

Source: ERS/USDA; FAO; Aliceweb

Soybeans have turned out to be the leading sector over the years. In 2004 the value of exports in the soybean sector (grain, meal and oil) was US$ 10 billion, which was almost twice the value of meat exports and almost four times sugar exports. Paper and cellulose export value was US$ 2.9 billion, slightly lower than leather and shoes at $3.3 billion. Brazil's total value export for major agricultural products was US$ 31 billion in 2004, almost 3 times the value in 1995.

Putting Brazil in perspective vis-à-vis the United States, some comparative summary data on population, land areas, production and exports are given in Table 2. Brazil's population and total agricultural area are about 60 percent

below that of the United States but growth rates are much higher in Brazil. Area harvested of wheat, soybeans and corn in Brazil is less than half of that in the United States but the growth rate is almost eight times that in the United States.

The average production level of commodities listed in Table 2 is four times higher in the United States but average growth rates are almost three times higher in Brazil. Notice that the average exports of wheat, soybeans, corn and meat is 3 times higher in the United States but growth rates average is seven times higher in Brazil.

Table 2. Comparative Data Brazil and United States

	Brazil		USA		% change Brazil-USA	
	level	**growth rate**	**level**	**growth rate**	**level**	**growth rate**
Population	186.4	1.3%	298.2	1.2%	60.0%	-7.7%
Agricultural Area	263,580	0.9%	411,877	-0.2%	56%	-122%
Area Harvested	36,652	4.9%	79,928	0.6%	118%	-88%
Production						
maize	41,947	6.1%	298,233	5.1%	611%	-16%
soybean grain	49,205	7.6%	85,741	4.5%	74%	-41%
wheat	6,036	10.9%	58,881	0.8%	876%	-93%
beef and veal	7,774	4.7%	11,207	0.5%	44%	-89%
poultry meat	8,668	9.8%	18,003	3.8%	108%	-61%
pig meat	3,110	7.0%	9,332	1.2%	200%	-83%
average	*19,457*	*7.7%*	*80,233*	*2.7%*		
Exports						
Crops	39,661	96.2%	101,556	0.8%	156%	-99%
Meat	4,356	21.7%	4,542	13.4%	4%	-38%
average	*15,050*	*28%*	*42,733*	*4%*		

Source: http://globalis.gvu.unu.edu/indicator_detail.cfm?country=AF&indicatorid=132 and FAO; IBGE

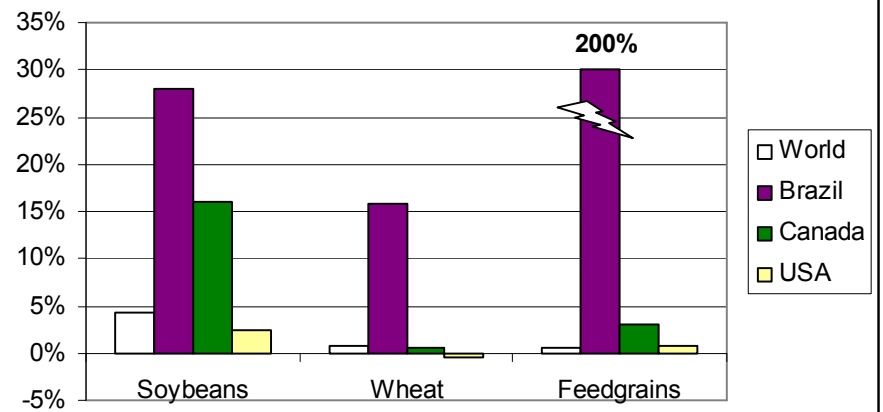
Note 1: Per million Inhabitants related to population.

Note 2: Per 1000 ha of land related to agricultural area and wheat, soybeans and corn area harvested.

Note 3: Per 1000 tonnes of production and wheat, corn, soybeans, pig meat, bovine meat and poltry meat exports.

The magnitude of soybeans export growth rates from 1980 to 2003 can be visualized in Figure A. Brazil's soybeans exports increased 28 percent in the period in analysis representing almost 20 percent of the total amount of soybeans exported in the world. Although wheat and feed grains present high growth rates, the amount exported is not significant compared to Canada and United States.

Fig. A: Export Growth Rate 1980-2003



Tables 3 (a and b) and table 4 (a and b) present, respectively, export quantities and export value for major agricultural and agri-food product categories through 2004. For instance, you can notice from table 3a and 3b that soybeans export quantity increased four times in the last 3 years and sugar increased six times. Meat is another product with a remarkable export expansion. The export value of cattle meat increased 400 percent from 1994 to 2004 and chicken meat 300 percent.

The volume of coffee exports increased 160 percent but in terms of value, it decreased by 50 percent. Cocoa had a decrease in quantity and value of around 30 and 60 percent, respectively. Orange juice trade did not change appreciably in the period of analysis.

Table 3a. Export quantity (in tonnes)

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Soybean	**meal**	10,635,294	11,562,941	11,233,398	10,013,356	10,446,984	10,427,878	9,372,412	11,270,729	12,517,153	13,602,158	14,485,623
	grain	5,403,589	3,492,524	3,646,933	8,339,590	9,274,751	8,917,209	11,517,264	15,675,542	15,970,002	19,890,466	19,247,688
	raw oil	1,518,437	1,703,713	1,283,132	1,013,437	1,194,631	1,297,052	935,087	1,651,526	1,934,387	2,485,957	2,511,519
	purified oil	15,866	33,622	9,354	-	-	-	-	-	-	-	500
	Total	17,573,186	16,792,800	16,172,818	19,366,384	20,916,366	20,642,140	21,824,763	28,597,797	30,421,543	35,978,582	36,245,330
Cocoa	**in almond**	87,465	18,772	33,274	4,915	5,582	3,918	1,900	3,272	3,590	1,851	1,112
	butter	35,799	24,980	24,667	20,807	24,931	22,065	30,395	24,045	27,900	33,637	34,131
	paste	22,132	9,458	8,276	15,800	20,485	16,291	16,480	16,819	13,120	20,007	16,634
	processed	21,331	12,809	12,699	-	-	-	-	-	-	-	-
	Total	166,727	66,019	78,915	41,522	50,998	42,274	48,775	44,136	44,610	55,496	51,877
Coffee	**grain**	871,223	721,305	777,906	868,439	995,104	1,271,106	963,698	1,252,324	1,551,033	1,368,747	1,411,220
	soluble	62,314	58,298	55,908	51,950	37,556	43,922	45,491	55,443	56,431	63,283	71,239
	Total	933,537	779,603	833,814	920,389	1,032,659	1,315,028	1,009,189	1,307,767	1,607,463	1,432,030	1,482,459
Textile	**yarn**	31,629	24,028	17,449	13,811	10,748	16,008	17,830	17,083	26,187	45,964	27,837
	wool	n/a	n/a	352	3,496	3,179	3,456	4,467	4,327	3,496	3,018	2,124
	cloth	49,171	46,992	38,864	43,532	45,516	37,769	46,658	54,331	46,234	63,857	62,282
	Total	80,800	71,020	56,665	60,839	59,442	57,233	68,955	75,741	75,917	112,839	92,243
Fruits and juices	**Bananas**	51,866	12,163	29,949	40,062	68,555	81,227	71,812	105,112	241,038	220,771	188,086
	Cashew-nut	n/a	n/a	30,749	36,349	31,882	24,101	33,588	29,356	31,262	41,569	47,442
	Brazil-nut	n/a	n/a	2,356	14,661	15,129	6,106	18,928	10,552	9,643	7,380	13,106
	Oranges	140,276	114,060	99,223	91,662	65,615	103,086	75,345	139,582	40,374	68,016	90,119
	Melons	n/a	n/a	39,089	45,729	65,005	65,453	60,904	99,434	98,690	149,758	142,587
	Other fruits	n/a	n/a	25,557	94,581	102,931	180,932	225,876	221,815	370,481	424,564	438,334
	Orange juice	1,146,857	960,905	1,180,098	1,179,571	1,227,872	1,168,135	1,224,461	1,219,525	1,002,816	1,054,142	1,010,258
	Other juices	6,954	1,808	2,560	-	-	-	-	-	-	-	-
	Total	1,345,953	1,088,936	1,409,581	1,502,616	1,576,988	1,629,039	1,710,915	1,825,376	1,794,304	1,966,199	1,929,932

Source: Secex

Table 3b. Export quantity (in tonnes)

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	Shrimp	7,747	4,108	3,041	2,277	2,623	4,813	13,228	23,408	39,960	60,822	54,379
	Lobster	2,818	3,021	2,790	2,027	1,816	1,718	2,039	2,335	2,771	2,415	2,562
	Frozen fish	26,426	11,783	11,310	14,865	13,511	24,030	35,635	39,455	45,422	41,527	39,636
	Others	n/a	n/a	316,116	4,977	6,239	1,468	1,533	2,070	4,113	2,918	3,568
Fish and others	**Total**	36,991	18,912	333,257	24,146	24,189	32,029	52,436	67,268	92,266	107,681	100,145
	Cellulose	n/a	n/a	321,942	2,505,058	2,805,802	3,110,714	3,013,830	3,338,262	3,449,586	4,570,440	4,988,790
	Paper	n/a	n/a	195,352	1,329,435	1,216,894	1,329,657	1,224,546	1,367,740	1,454,905	1,777,566	1,852,877
Paper and celulose	**Total**	n/a	n/a	517,293	3,834,493	4,022,696	4,440,371	4,238,375	4,706,002	4,904,491	6,348,006	6,841,667
	Leaves	275,543	256,270	282,364	318,954	300,494	340,924	341,448	435,395	464,862	465,973	579,365
	Cigarettes	n/a	n/a	73,317	87,312	87,169	8,058	843	521	1,657	2,614	3,370
	Others	n/a	n/a	405	3,652	5,162	9,764	10,731	7,925	7,947	8,953	10,097
Tobacco	**Total**	275,543	256,270	356,086	409,918	392,825	358,746	353,022	443,840	474,466	477,541	592,832
	Shoes	n/a	n/a	81,958	91,556	85,145	94,623	113,202	116,370	107,150	116,781	123,244
	Leather	n/a	n/a	155,722	216,493	227,002	204,689	204,019	223,452	241,484	263,272	321,747
	Leather products	n/a	n/a	1,037	10,242	10,790	12,638	13,210	17,729	24,737	24,147	26,545
Leather and shoes	**Total**	n/a	n/a	238,717	318,291	322,937	311,949	330,431	357,551	373,371	404,199	471,536
	Cattle meat in natura	78,718	37,505	46,657	52,441	80,850	150,740	188,656	368,288	424,271	620,117	923,072
	Chicken	490,271	430,863	567,949	649,347	612,478	776,362	916,094	1,265,881	1,624,887	1,959,773	2,473,859
	Cattle meat processed	109,428	95,243	85,896	89,061	107,876	140,837	126,225	134,706	162,633	182,279	235,784
	Others	n/a	n/a	19,851	112,274	134,142	146,579	213,112	384,819	621,057	675,556	722,944
Meat	**Total**	678,417	563,611	720,353	903,124	935,346	1,214,518	1,444,087	2,153,694	2,832,849	3,437,725	4,355,659
	Demerara	624,851	1,362,147	837,633	0	0	0	0	0	0	0	0
	Cristal	2,117,996	3,437,865	3,272,684	3,844,224	4,788,981	7,821,980	4,344,076	7,089,873	7,630,323	8,353,676	9,497,334
	Refined (purified)	659,344	1,117,860	1,017,236	2,527,746	3,575,266	4,273,123	2,158,298	4,083,341	5,723,976	4,560,704	6,360,611
Sugar	**Total**	3,402,191	5,917,872	5,127,552	6,371,969	8,364,246	12,095,104	6,502,373	11,173,214	13,354,299	12,914,380	15,857,945
TOTAL		**24,493,345**	**25,555,043**	**25,845,052**	**33,753,690**	**37,698,694**	**42,138,431**	**37,583,322**	**50,752,388**	**55,975,578**	**63,234,678**	**68,021,626**

Source: Secex

Table 4a. Export value (1,000 US$)

Exports in 1,000 US$		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Soybean	meal	1,980,026	1,996,716	2,727,634	2,680,885	1,749,876	1,503,180	1,676,559	2,065,192	2,198,860	2,602,374	3,270,889
	grain	1,315,980	770,425	1,017,917	2,452,427	2,175,428	1,593,293	2,187,879	2,725,508	3,031,984	4,290,443	5,394,906
	raw oil	828,062	1,107,152	685,333	531,617	720,098	564,202	310,415	505,881	778,058	1,232,550	1,378,733
	purified oil	11,018	21,905	5,554	0	0	0	0	0	0	0	263
	Total	4,135,086	3,896,198	4,436,438	5,664,929	4,645,401	3,660,676	4,174,853	5,296,581	6,008,902	8,125,367	10,044,790
Cocoa	in almond	107,835	25,042	46,557	7,865	9,273	4,758	2,004	3,785	7,000	3,074	1,874
	butter	117,718	58,509	91,193	85,054	99,305	67,688	66,092	47,820	75,188	99,762	104,715
	paste	41,901	19,015	17,270	22,648	31,668	22,344	19,067	21,948	27,959	57,542	33,963
	processed	13,256	7,662	6,915	0	0	0	0	0	0	0	0
	Total	280,710	110,228	161,936	115,567	140,246	94,790	87,163	73,553	110,147	160,378	140,553
Coffee	grain	2,218,688	1,969,846	1,718,579	2,745,289	2,330,408	2,229,508	1,559,125	1,207,574	1,195,000	1,302,282	1,749,809
	soluble	339,517	456,025	376,008	348,624	245,715	211,110	201,505	185,490	167,015	213,982	275,153
	Total	2,558,205	2,425,871	2,094,587	3,093,912	2,576,123	2,440,617	1,760,630	1,393,064	1,362,015	1,516,265	2,024,962
Textile	yarn	97,267	86,044	65,278	53,265	39,450	46,382	51,188	40,878	56,664	103,204	78,101
	wool	n/a	n/a	1,706	16,808	12,452	10,264	13,403	13,571	13,178	14,710	9,937
	cloth	194,121	213,418	189,591	240,092	228,197	150,806	179,177	213,883	172,668	239,589	266,796
	Total	291,388	299,462	256,575	310,165	280,099	207,453	243,768	268,333	242,510	357,503	354,834
Fruits and juices	Bananas	10,997	4,082	6,194	8,381	11,629	12,518	12,359	16,036	33,574	30,013	26,982
	Cashew-nut	n/a	n/a	143,217	156,917	142,575	142,124	165,059	112,251	105,648	143,760	186,375
	Brazil-nut	n/a	n/a	3,583	26,075	21,180	11,095	27,686	11,150	12,603	10,870	21,626
	Oranges	27,208	29,092	20,410	23,092	14,359	21,105	15,248	27,538	8,125	13,248	21,492
	Melons	n/a	n/a	19,942	20,913	28,323	28,733	25,005	39,297	37,778	58,316	63,251
	Other fruits	n/a	n/a	19,187	65,627	74,963	104,315	123,825	87,267	122,759	235,764	336,702
	Orange juice	985,476	1,105,079	1,391,664	1,003,015	1,262,339	1,235,055	1,019,256	812,554	869,308	910,269	789,683
	Other juices	6,510	2,093	6,941	0	0	0	0	0	0	0	0
	Total	1,030,191	1,140,346	1,611,137	1,304,020	1,555,369	1,554,946	1,388,438	1,106,094	1,189,796	1,402,238	1,446,112
Source: Secex												

Table 4b. Export value ($1,000 US)

Exports in 1,000 US$		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fish and others	**Shrimp**	64,800	42,132	33,827	24,778	26,673	39,277	105,236	129,402	174,939	244,472	218,866
	Lobster	59,120	68,869	55,207	47,034	40,701	40,115	50,688	58,572	70,979	65,324	81,364
	Frozen fish	29,552	18,890	17,308	19,443	16,805	37,501	61,243	72,562	76,217	83,729	92,159
	Others	n/a	n/a	2,494	19,063	19,405	7,686	9,965	10,372	12,061	18,119	23,560
	Total	153,472	129,891	108,836	110,317	103,585	124,578	227,133	270,907	334,195	411,645	415,949
Paper and celulose	**Cellulose**	n/a	n/a	136,828	1,024,207	1,049,436	1,243,628	1,602,407	1,247,590	1,161,237	1,744,464	1,722,368
	Paper	n/a	n/a	143,692	966,304	929,883	900,758	941,005	940,487	894,321	1,086,656	1,186,693
	Total	n/a	n/a	280,520	1,990,511	1,979,318	2,144,386	2,543,412	2,188,077	2,055,559	2,831,120	2,909,061
Tobacco	**Leaves**	n/a	n/a	895,958	1,091,291	939,702	883,535	812,842	921,135	977,670	1,052,425	1,380,461
	Cigarettes	n/a	n/a	440,554	566,060	607,609	49,426	5,787	2,932	9,264	14,768	15,966
	Others	n/a	n/a	629	7,456	11,553	28,276	22,845	20,048	20,953	22,975	29,336
	Total	n/a	n/a	1,337,140	1,664,806	1,558,864	961,237	841,474	944,115	1,007,887	1,090,168	1,425,763
Leather and shoes	**Shoes**	n/a	n/a	1,521,062	1,594,441	1,386,660	1,342,278	1,617,066	1,684,301	1,516,433	1,622,173	1,898,806
	Leather	n/a	n/a	567,831	740,058	671,189	600,148	760,223	880,982	963,504	1,061,868	1,293,042
	Leather products	n/a	n/a	9,261	68,839	66,965	66,737	68,479	75,314	108,744	119,285	145,056
	Total	n/a	n/a	2,098,154	2,403,338	2,124,814	2,009,163	2,445,767	2,640,598	2,588,681	2,803,326	3,336,904
Meat	**Cattle meat in natura**	268,090	180,778	194,306	196,295	276,595	443,835	504,296	738,805	776,318	1,154,509	1,963,066
	Chicken	609,357	633,798	837,077	875,839	738,925	892,753	828,746	1,333,797	1,392,816	1,798,954	2,594,905
	Cattle meat processed	287,465	292,874	231,073	238,783	313,641	360,375	276,323	274,890	319,753	363,707	504,052
	Others	n/a	n/a	40,454	223,058	232,294	210,069	296,536	522,273	639,853	776,517	1,091,638
	Total	1,164,912	1,107,450	1,302,909	1,533,975	1,561,456	1,907,032	1,905,902	2,869,764	3,128,740	4,093,687	6,153,661
Sugar	**Demerara**	173,242	408,146	256,137	0	0	0	0	0	0	0	0
	Cristal	614,501	1,042,425	934,525	1,045,395	1,094,687	1,161,367	761,491	1,400,827	1,111,343	1,372,905	1,510,982
	Refined (purified)	195,067	366,300	332,029	725,929	846,194	748,390	437,620	878,232	982,293	789,963	1,129,245
	Total	982,810	1,816,871	1,522,691	1,771,324	1,940,881	1,909,757	1,199,111	2,279,058	2,093,636	2,162,868	2,640,227
TOTAL		**10,596,774**	**10,926,317**	**15,210,923**	**19,962,865**	**18,466,156**	**17,014,635**	**16,817,650**	**19,330,145**	**20,122,069**	**24,954,566**	**30,892,816**

Source: Secex

How can one explain the growing Brazilian market share on international commodities markets? Developing a comparative advantage[1] in agricultural and agri-food production has been the key force. Behind this observed expansion in exports is the high production efficiency and low cost of production. Brazilian agriculture has probably one of the lowest costs of production for a considerable number of commodities.

To support this assertion, we present a number of tables on costs of production for several key commodity sectors commodities in different countries of the world. The general idea is to give an overview of Brazil's cost pattern relative to its major competitors. This sort of comparison is not always that precise: not only are costs of production difficult to measure, methodologies differ considerably among different countries. Nevertheless, care has been taken in the sense of finding studies (sources) that are specialized in each of these markets. The important point to notice is that although one cannot take costs comparisons among countries literally (unless methodologies are the same), the general picture shows a robust argument towards the idea that Brazil enjoys a comparative advantage in agricultural production.

Sugar and alcohol

Since the 1970's and especially in the 1980's, Brazil produced alcohol and sugar from sugar cane in the country through an alcohol production program known as PROALCOOL. This government program was intended to develop cars using 100% alcohol. In addition, alcohol has been used together with gasoline, representing 24 percent of the total fuel consumption. In 2004 Volkswagen, Ford, General Motors and Fiat launched the flex fuel engine in Brazil that allows a fuel mixture using any proportion of gas and alcohol. This successful program induced a technological development that made the sugar and alcohol industry very competitive. In addition to the high productivity and low climate risk in sugar

[1]With international trade, a country tends to have a comparative advantage in the production of goods that requires a more intense use of inputs that are relatively more abundant domestically than abroad. The most general example is a country that has an advantage in exporting grains because of its abundant land vis-à-vis capital supply (China, India, for example).

cane production, the sugar and alcohol sector probably has the lowest cost of production in the world. Table 5 shows the cost of production in US$ per ton for two different regions in Brazil, Australia, Europe and Thailand. Notice that the cost in São Paulo (the state with the highest level of production) is less than half the cost in Australia and Thailand.

Table 5. Sugar cost in Brazil, Australia, Europe and Thailand in 2003 (US$/tonne)

Sugar

Countries	U$/ton
Brazil- North East	150
Brasil - São Paulo	130
Australia	335
Europe	710
Thailand	335

Source: Australia, Tailand and European Comunity - Netherlands Economic Institute (NEI); Brazil - UNICA

Comparing the cost of alcohol production between Brazil and the United States, Brazil's cost of US$ 0,15-0,18 per liter is significantly lower than that in the United States of US$ 0,33 per liter.

Table 6. Alcohol cost in Brazil and USA in 2004 (U$/liter)

Country	Anhydrous Alcohol (U$/l)	Basis
Brazil		
Midle-South	0.15	sugar cane
North-Northwest	0.18	sugar cane
USA*	0.33	corn
Europe	0.55	beet, wheat

Sources: Governors' Ethanol coalition/ÚNICA; World Bank

Soybeans and corn

There is an advantage in costs of production in Brazil for soybeans relative to the United States, although Argentina has the lowest cost in the world (table 7). This relative advantage is basically due to higher fixed costs in the United States as a consequence of land prices. If one considers only operating costs, the figures

are much the same. Logistics is another relative advantage of the developed world. [2]

Table 7. Soybean total cost

(in US$/60 kilos)

Country and regions	U$/60 kg
Brazil Paraná	10.83
Brazil Mato Grosso do Sul	11.46
Brazil Mato Grosso	10.84
Brazil Goiás	10.64
USA (2003)	14.6

Source: Conab; USDA

Corn operating cost is very similar in Brazil and the United States, although productivity is much higher in the latter. Operating costs in both countries are around US$ 79 per ton.

Table 8. Operating cost of corn at Brazil and USA in 2003

(in US$/ton)

	USA Illinois	Campo Mourão - PR(1)	Rio Verde - GO(1)
Yield (ton/ha)	**8.40**	**5.03**	**5.42**
Operating Cost (US$/ton)	**79.4**	**75.5**	**79.5**

(1) Includes first and second crop.
Source: Conab; University of Illinois (Agricultural Dept.)

Cattle

Cattle are basically produced on pasture land in Brazil. Total pasture land is around 170 million hectares, although the last available data is for 1995 (IBGE, Agricultural Census). This results in a low cost of production. Table 9 indicates that Brazilian beef has a much lower cost than any other country. It is interesting to notice that as far as food safety is concerned, pasture as basic feed assures

[2] There are many differences in land prices in Brazil. At the frontier, in areas yet to be developed land prices are around U $ 100 per acre. However, at the Center, where crop production is already well developed, prices are around U$ 1,000 to 2,000 per hectare depending on transportation costs and weather conditions.

low level of sanitary concerns and low risk of the spread of diseases through feedstuffs.

Table 9. Cattle meat cost of production
(2002)

Country	US$/Kg
Brazil	**0.95**
New Zeland	1.23
Argentina	1.30
Australia	1.80
USA	1.90
Ireland	3.00

Source: Ministry of Agriculture
(in: Pratini de Moraes)

Coffee

Brazil is a traditional coffee producer, claiming more than 30% of international exports. Vietnam and Colombia are the major competitors but Brazilian production cost is lower than both. Table 10 presents the cost of production in different countries.

Table 10. Coffee costs of production in selected countries, 2002
(U$/kilogram)

Country	Average cost (US$/60 kilo)
Brazil	60
Tanzania	66
India	69
Papua NG	77
Peru	79
Nicaragua	93
Honduras	93
Kenya	93
Etiopia	93
Equador	96
Mexico	99
Guatemala	106
Colombia	106
Venezuela	106
El Salvador	106
Costa Rica	119

Source: in Technoservice and Conab for Brazil

Oranges

World orange juice production is concentrated in the United States and Brazil. But Brazil is responsible for approximately 80% of world exports (table 11). As can be seen in table 10, Brazil's costs of production are less than 50 percent of that in the United States.

Table 11. Oranges: Costs of production in USA and Brazil, 2002

(U$/box)

Operating costs	São Paulo (U$)	Flórida (U$)
Total operational cost	1,056.5	2,011.8
Taxes	75.3	320.5
Transpor and harvest	458.3	2,205.8
Total (U$/ha)	1,590.1	4,538.2
Total Geral (U$/box)	1.9	4.2

Fonte: Pozzan, M.; Muraro, R.P.;Ueta, F.Z. (2002)

Cellulose

Wood, paper and cellulose production increased sharply in Brazil during the last 25 years. As a consequence of the adaptation and development of different varieties of Eucaliptus spp and Pinus spp, large scale plantations accelerated the supply of wood supply. Average cost is similar to that in Indonesia, although some highly productive firms have a much lower cost of production. High interest rates are responsible for a significant part of Brazil's cost, indicating that if interest rates were more or less the same among competitors, Brazilian comparative advantage in wood would be even larger.

Table 12. Cellulose production cost in selected countries

Country	U$/ton
Brazil - VCP(*)	140
Indonesia	246
Brazil	259
USA	294
Canada	306
Finland/Sweeden	317
Portugal/Spain	343

Source: Lopes (2003)

Wheat

Wheat is a crop that Brazil has a disadvantage in production. About 50 percent of domestic consumption is imported. So far, there has been no variety of quality adapted to the "cerrado" with a high productivity in production. Almost all production comes from the south (state of Paraná), cultivated as a winter crop. Productivity is relatively low in Brazil and Argentina's production is always contesting the domestic market. As can be seen in table 13, average productivity is much lower in Brazil than in the United States and costs much higher. Imports will probably be an important part of domestic consumption. **Wheat constitutes a good opportunity to Canada as a future Brazilian supplier.**

Table 13. Wheat cost of production in Brazil and USA in 2004

	Productivity (ton/ha)	Operating cost (US$/ton)	Total cost (US$/ton)
Passo Fundo - RS	2.20	168	203
Londrina - PR	3.20	139	159
Cascavel - PR	2.50	157	183
Campo Mourão - PR	2.25	136	167
USA	3.71	100	195
USA	6.18	63	121
USA	8.65	47	89
USA	9.88	42	79
USA	11.12	38	71

Source: Conab; University of Illinois

The main assertions that are derived from the above discussion are:

I. Brazil has become an important international player. Although total agricultural production still far less than in the United States, the presence on international markets are relatively very high.

II. Technological development has allowed agricultural expansion towards the country's Center and North regions that are characterized by land abundance (low prices) and low weather risk. It is important to notice that there is room for a much larger expansion in cropland. In other words, what limits expansion are essentially demand forces, not supply. If international commodity prices are favorable, then supply is expected to respond.

III. This technological development together with productivity gains due to learning by doing has reduced unit costs of production. Data presented in this section suggests that in many animal and crop sectors, Brazilian agribusiness has one of the lowest costs of production in the world.

IV. The combination of these forces lives indicates that the participation of Brazilian agribusiness products on international markets will keep increasing.

V. Explaining the success

The relationship of the public sector to agriculture in Brazil has always been profound. It is difficult to understand the evolution of the sector in the country without taking into consideration the central government's policy interventions. It seems unnecessary for the purposes of the present section to go over all the facets of Brazilian agricultural policy. There is vast literature that addresses its evolution[3]. It is important, however, to emphasize that in the last 20 years the degree of interventionism has been substantially reduced. Throughout this period, the pillars of agricultural policy constructed in the 1960s and 1970s have been corroded, so much so that the resulting model at the end of the 1990s carries little correlation to the old one.

The model developed in the 1960s and 1970s had the central objective of guaranteeing the stability of the internal food supply, allowing the process of urbanization of the Brazilian economy to follow its course without major increases in the inflation rates. For this, a set of policies was constructed in order to stimulate the adoption of modern production inputs. The system was based on subsidized credit policies and income stabilization mechanisms like minimum prices and regulating stocks. Associated with these mechanisms of stimulating modernization were innumerable taxes on specific products, import and export quotas, and tariff barriers on inputs to agricultural products. Furthermore, part of this tax system carried some elements of the period in which agriculture was relevant in the formation of the rate of domestic saving in the Brazilian economy.

The tangle of interventions of the federal government (minimum prices, subsidized credit, taxes, tariff barriers, import and export quotas, etc.) made it difficult to identify the resulting effect of Brazilian agricultural policy. The combination of policies to stimulate production, with those of food price control, as well as the taxation of export products, generated an environment in which the effect of the public policies on agricultural production was unknown.

[3] See Barros (1999) for a survey.

The work of Brandão and Carvalho (1990) and an earlier study by Oliveira (1976) constitute referential milestones in understanding the distortions generated by governmental interventions in Brazilian agriculture, including the compensating role played by subsidized rural credit. The first authors make use of a partial equilibrium model in seeking to investigate the direction of the market forces reflected in the movements of relative prices. The results of the study make clear that agriculture suffered discrimination as a result of the direct and indirect interventions in the prices of agricultural products. Excluding the policy of rural credit, the authors estimate that approximately 8.9% of the agricultural GDP (on average for the period 1975 to 1983) was shifted from the agricultural sector to other sectors of the economy. This transfer was a consequence of a different number of taxes and price controls that were set in a complex and not very organized way. Changes in price control policies were frequent, depending on inflationary problems due to low production, for example. Goldin and Rezende (1993) has a good description of these policies.

The distortions in products prices ended up reducing the amount of food that otherwise would have been produced under competitive market conditions. According to Brandão and Carvalho (1990), the actual production was below the expected production in a situation of free trade for all the products analyzed (cotton, soybeans, corn, rice and wheat). Corn production, for example, was between 4 and 39% below what it could have been. Furthermore, the food producing sector was favored in the period. The exporting sector faced prices on average 10 to 30% lower than they would be in a market condition without any intervention whatsoever. These distortions reduced the total supply of exportable products by nearly 10%. Basically, the disadvantage of export products were a consequences of exports taxes that were used to guarantee domestic supply. Only domestic surpluses were allowed to be exported.

Though interventions in the markets generated a drain of resources from the sector, signaling a “bias against agriculture”, the policy of subsidized rural credit would compensate for this movement. According to Brandão and Carvalho (1990), when the subsidies in rural credit were introduced into the analysis, the

agricultural sector received on average the equivalent to 8% of the agricultural GDP in the period from 1975 to 1983. This inversion in the sign of the surplus received by the sector gives an indication of the magnitude of the rural credit provided between the mid-70s and the mid-80s.[4]

Indeed, the pattern of accumulation generated by the rural credit policy was significant. The volume of resources involved in the program, as well as the negative real interest rates originating from inflationary acceleration, had a non-neutral effect on the relative prices of inputs and products. There were mechanisms of rationing that clearly favored the adoption of modern inputs, especially machines and equipment. The growth of agriculture in that period took on an extensive pattern, in which the functioning of the rural credit policy stimulated an increase of the cultivated area associated with the use of machines and fertilizers. Though there was a significant rise in the use of modern factors of production and in the cultivated area throughout the 1970s, the productive efficiency gains were relatively low (Barros and Graham, 1978; Barros and Dias, 1983; Barros, Graham and Gautier, 1987; and Goldin and Rezende, 1993). At any rate, the amount of capital invested to the sector was of such magnitude that the growth rates of production were remarkable, reaching annual increments in the order of 4 to 6%.

As can be seen in figure 1, total area harvested has grown considerably during the 1960s and 70s. Major crop harvested area increased from 22 million in 1960 to 45 million hectares in the end of the 1970s[5]. One observation that will be analyzed in the next section is that total area stopped increasing in the 1980s and 90s; major crop harvested area has been oscillating around 45 to 50 million

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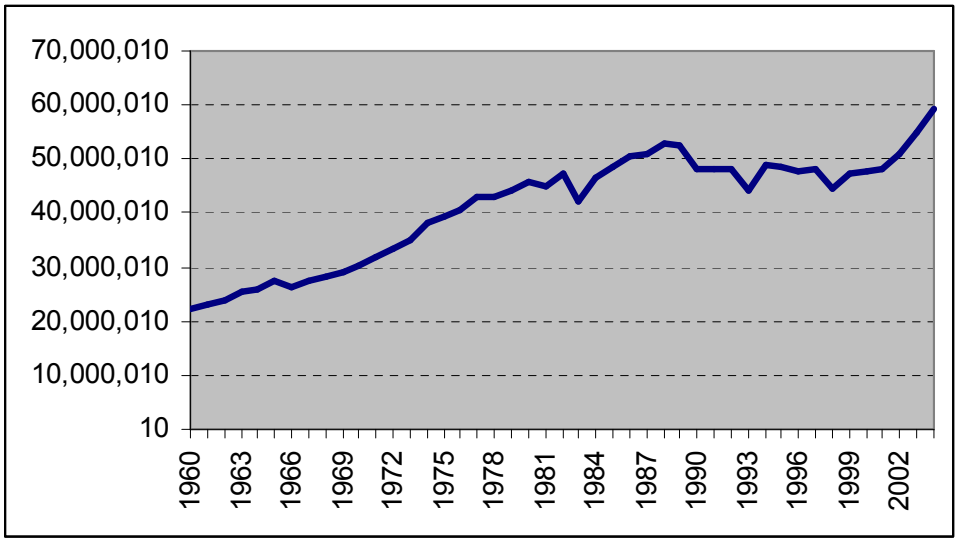
[4] It should be remembered, however, that part of the subsidy was absorbed by the input industries. As shown in the work of Oliveira (1987), the protection conceded to the modern inputs industry in the 70s, particularly fertilizers and farm machinery caused the interest rate subsidy to be partially appropriated by these firms.

[5] Data is not available for 1971 and 1972. In figure 1, we average the difference between the 1970 and 1973 data.

hectares during this entire period. Only after 1999 did the area planted start to grow again[6].

Figure 1. Brazilian harvested area with major crops, 1960 to 2004 (in hectares)

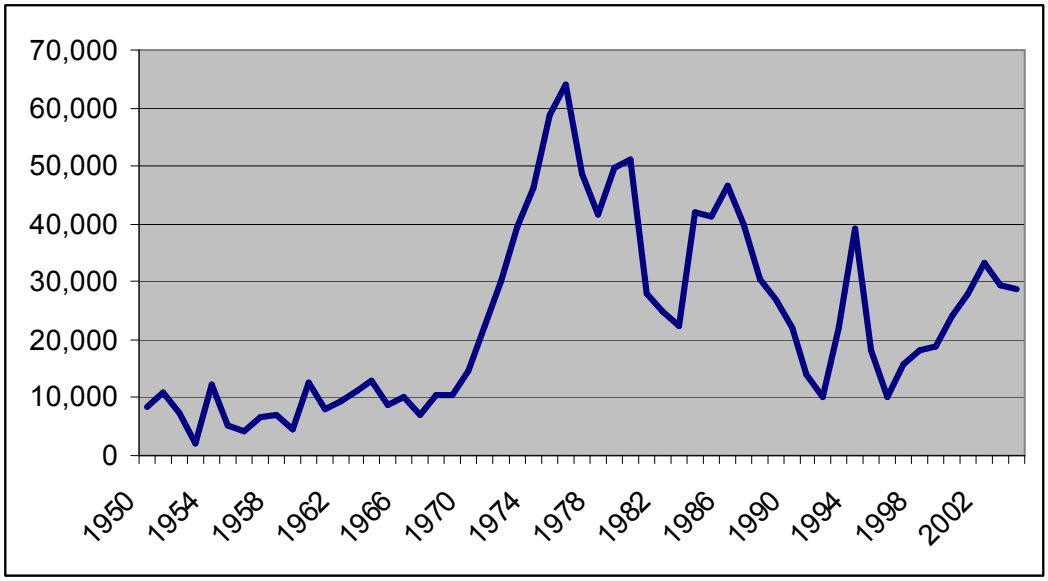


Source: IBGE

The area expansion during the 1960s and 70s was accompanied by modern inputs adoption, as mentioned before. Until 1970, domestic tractor sales were low and based on imported machinery. With the establishment of tractor factories, domestic production started to increase considerably. With the help of subsidized credit, domestic sales increased, reaching a peak in 1976 with almost 64,000 units sold. This expansion continued until mid 1980s, when domestic sales went down again, to recover again only in the end of the 1990s. Figure 2 presents the data on domestic wheel tractor sales.

The next section explains the dynamics of agricultural production in Brazil for the recent time period.

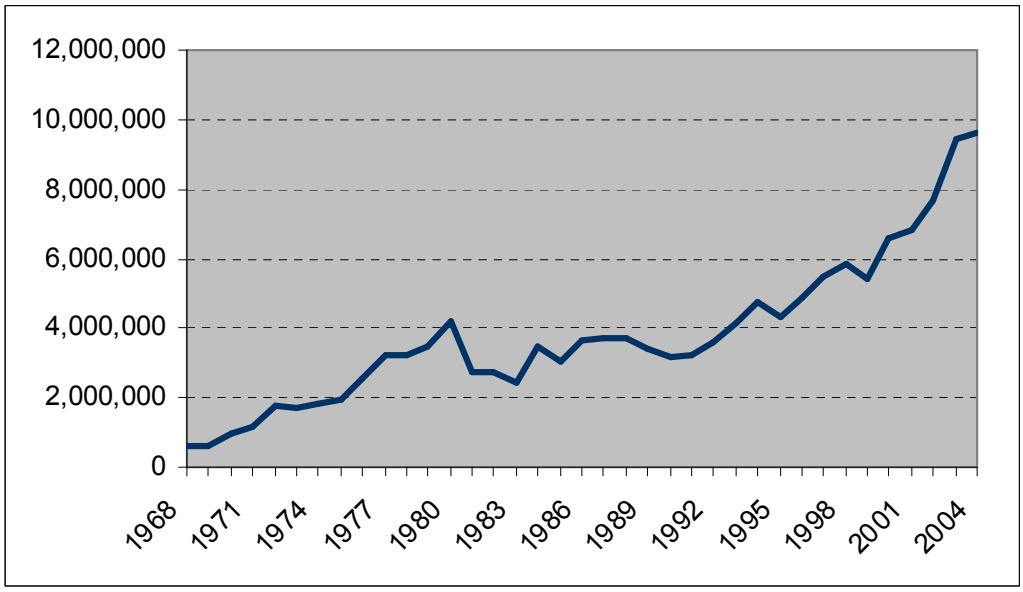
Figure 2. Brazilian wheel tractor domestic sales, 1970-2004
(in number)



Source: ANFAVEA

Fertilizer consumption was also an agricultural input that grew sharply during the 1970s. Figure 2 presents the data, indicating that domestic consumption in 1968 was around 600 thousands tons. At the beginning of the 1980s, sales went up to 4 million tons, which was maintained throughout the decade; only in the beginning of the 1990s did fertilizer domestic consumption start to recover and then expanded sharply after 2000. This point will be commented on in the next section.

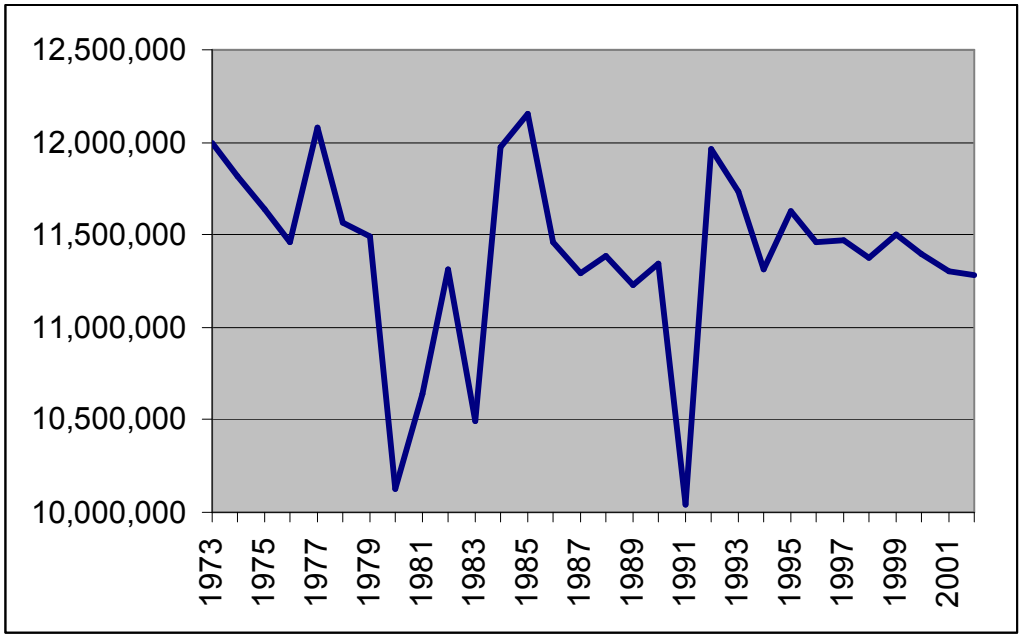
Figure 3. Brazilian fertilizer consumption, 1968-2004
(in ton of nutrient)



Source: ANDA

Unlike machinery and fertilizer, the number of laborers in agriculture has shown no growth during the period of 1970 to 2002. Agricultural labor has oscillated around 12 to 10 million people, with a slight reduction towards the end of the period. It is important to notice that during the 1980s and 1990s, Brazil's economy has grown slowly and in an erratic pattern; in this context, urban labor demand has varied together with GDP movements, affecting labor in the agricultural sector. Figure 4 summarizes agricultural labor behavior.

Figure 4. Agricultural labor, 1973-2002
(in number)



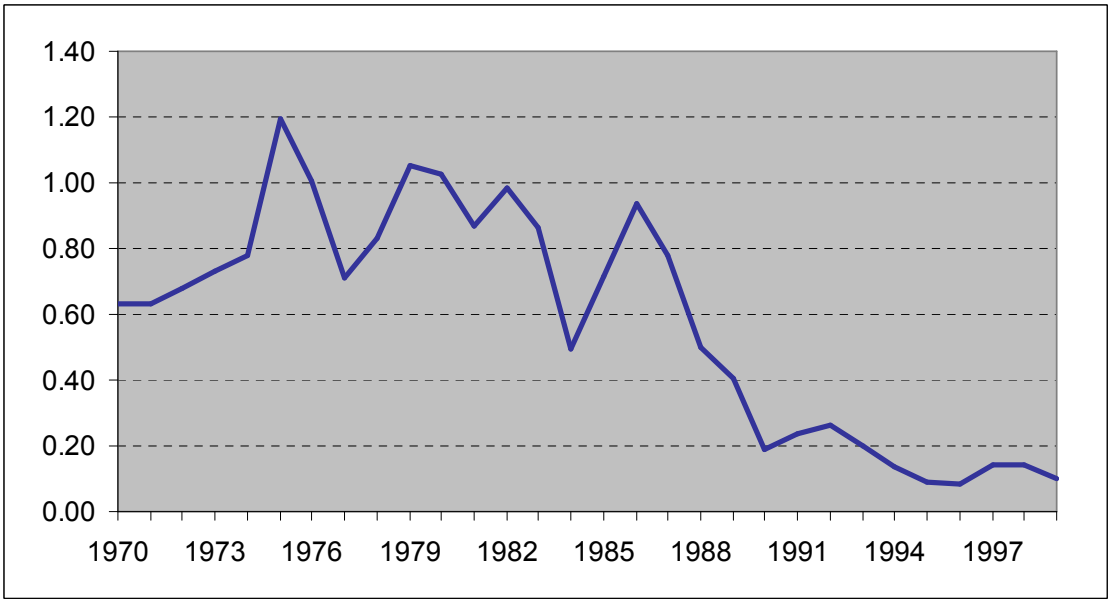
Source: IBGE and Gasques et alii (2004)

The macroeconomic imbalance that began to characterize the Brazilian economy at the beginning of the 1980s would make it infeasible to maintain the pattern of area expansion growth in Brazilian agriculture. The conjunction of the second oil shock and the external financing crisis of 1982 exhausted the capacity of the central government to transfer resources to the private sector. The recession and adjustment along with public spending cuts combined with a restrictive monetary policy heavily affected the agricultural sector, reducing the amplitude of both the policy of minimum prices and the rural credit system. The guaranteed prices were progressively lowered, approaching the actual market prices.

The magnitude of the reduction in the volumes of rural credit conceded can be better visualized with the help of Figure 5. It presents the ratio between the amounts conceded by the formal system of rural credit and the agricultural GDP. It is possible to note clearly the break in the trend of the series as of the mid-80s. Already in 1984 there was a reduction in the amounts conceded; the Cruzado Plan in 1986 would, for the last time, restitute the previous patterns of credit

subsidies but lasted only one year. We can see that whereas in the 1970s the volume of government induced credit was close to the agricultural GDP, at the end of the 1990s this ratio falls to levels that range between 8 and 10%.

Figure 5. Ratio between Formal Credit and Agricultural GDP, Brazil, 1970-1999



Source: The credit data were taken from Almeida (1996) and BACEN. The agricultural GDP data from BACEN.

Figure 5 also shows the amount of capital received by Brazilian agriculture between the mid-1970s and 1980s. Considering that the negative real interest rates oscillated between –1.5% and -37.7% in the period from 1970 to 1987, (Goldin and Rezende,1993), one can conclude that the transfer of income to the rural sector was very significant in the period in question, as the work of Brandão and Carvalho has already shown. The aggregate numbers mask, however, the magnitude of concentration in the rural credit distribution. According to a study by World Bank (1989), it is estimated that in the 1970s only 20 to 25% of the farmers received credit conceded by the official system; of these, less than 5% of the farmers received more than half of the total conceded credit.

It would be expected that such a drastic reduction in the volume of capital transferred to agriculture would alter its growth pattern. The rhythm of capital accumulation would have to slow down. This fact is clearly perceivable when inspecting the evolution of cultivated area in the country, as well as in the behavior of the tractor stock during the 1980s.

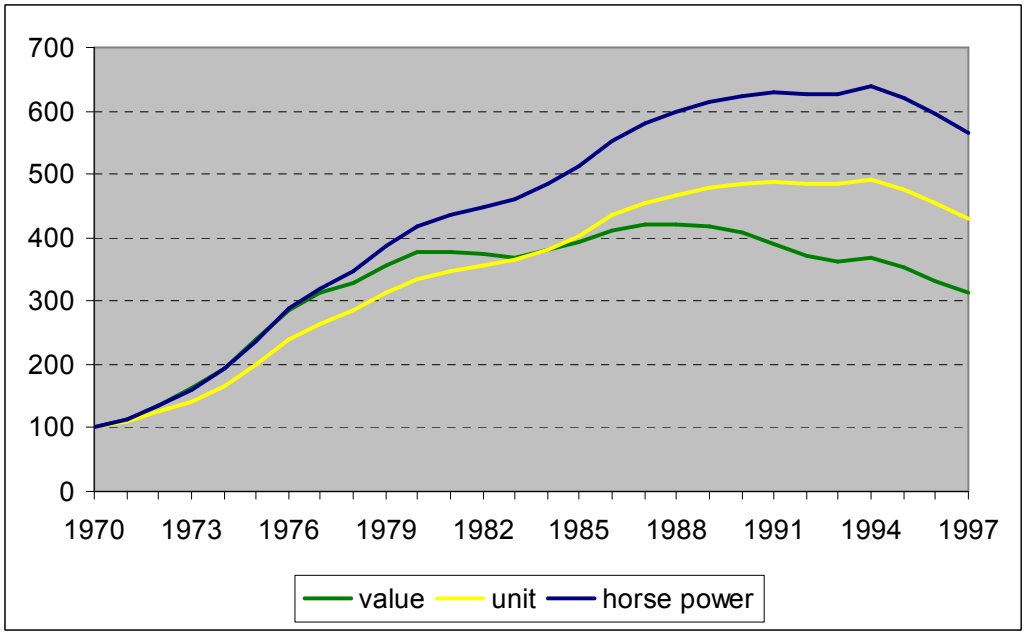
As can be observed in figure 1, the area harvested with permanent and temporary cultivation remained practically constant in the period following 1980. It is possible to see that the cultivated area had been consistently increasing since the 1960s. The inflection of the series is quite visible at the beginning of the 1980s. This sudden change reflects the importance of official credit in the expansion of total cultivated area.

Another way to evaluate the reduction in agricultural investments is based on analyzing the evolution of the stock of machinery in agriculture. Barros (1999), working with the series of sales of wheel tractors, constructed alternative measures of the stock of tractors in Brazil. The author made use of price series of second-hand tractors in order to estimate the economic depreciation of the stock of tractors. The function of depreciation assumed a declining geometric format, with depreciation rates oscillating between 6 and 7% a year, depending on the model of tractor considered. Having in hand the annual sales of wheel tractors by class of power, the data contained in the Agricultural Census, and the estimated rate of depreciation, Barros constructed, year by year, the stock of wheel tractors expressed in potency (hp), in number of tractors (units), and in value (1995 R$ considering the depreciation rates of 6 and 7%).

The results can be seen in figure 6. The aspect to be highlighted is the aging process of the tractor stock in Brazil. The value of the fleet reached its peak at the end of the 1980s, when its value was four times greater than in 1970. However, from that point on, the trend changed clearly, having reduced its value by more than 20%. It is perceivable, therefore, that the alterations in the economic conditions in the 1980s heavily affect investments. Note that the

amount of capital invested on tractors in 1995 is equivalent to the amount in 1979.

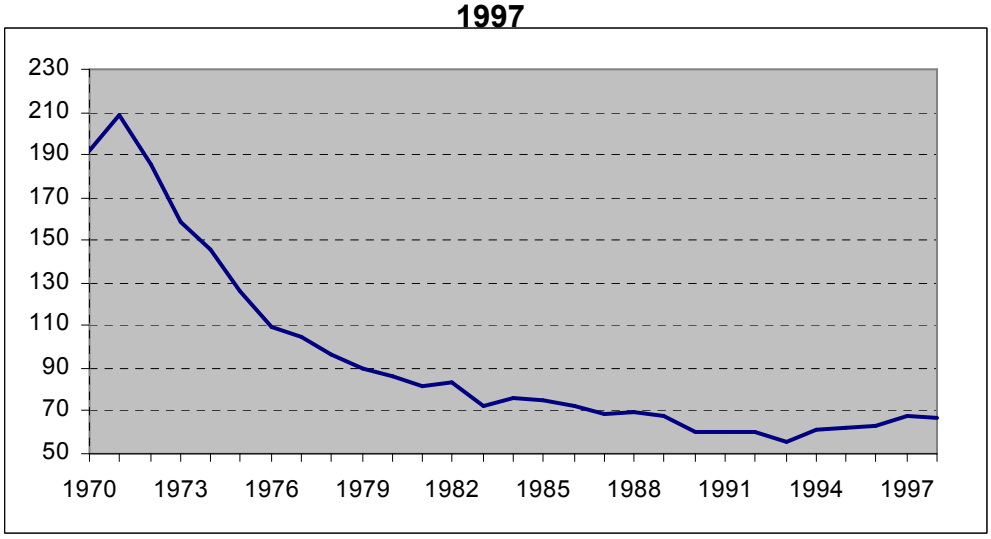
Figure 6. Index of the Stock of Tractors Measured in Value, Number of Tractors, and Horsepower Between 1970 and 1997 (1970=100)



Inspection of figure 6 further allows a better visualization of the relative movements of the series. The growth rate of the stock value was greater than the growth rate of the number of tractors from the beginning of the 1970s until the mid-80s. This movement is typical of economies in expansion. Starting with a small stock, high annual increases raise the value of the stock more than proportional to the number. We see however, that this trend was reverted and, as of the 1980s, the rate of decline in the value became much more accentuated than that of the number of tractors, indicating the aging of the fleet. It is worth noting that the stock of tractors increased almost 5 times in number between 1970 and 1990. What most calls attention, however, is the evolution of the accumulated potency. Between 1970 and 1994 the stock of tractors measured in horse power increased more than 6 times, suggesting an elevation of the average potency of the tractors. Even so, it is perceived that all the series indicate a trend of reduction of the stock as of 1994, which, in fact, could be signaling an environment of uncertainty in a none-too-distant future.

The process of capital accumulation in agriculture in the 1970s and mid-80s was, in fact, significant. The increase in the number of tractors in the country caused the number of hectares per tractor to drop notably. Whereas in 1973 165 ha per tractor were cultivated, in 1995 this number was 64 (Figure 7).

Figure 7. Number of Cultivated Hectares per Tractor Between 1973 and 1997



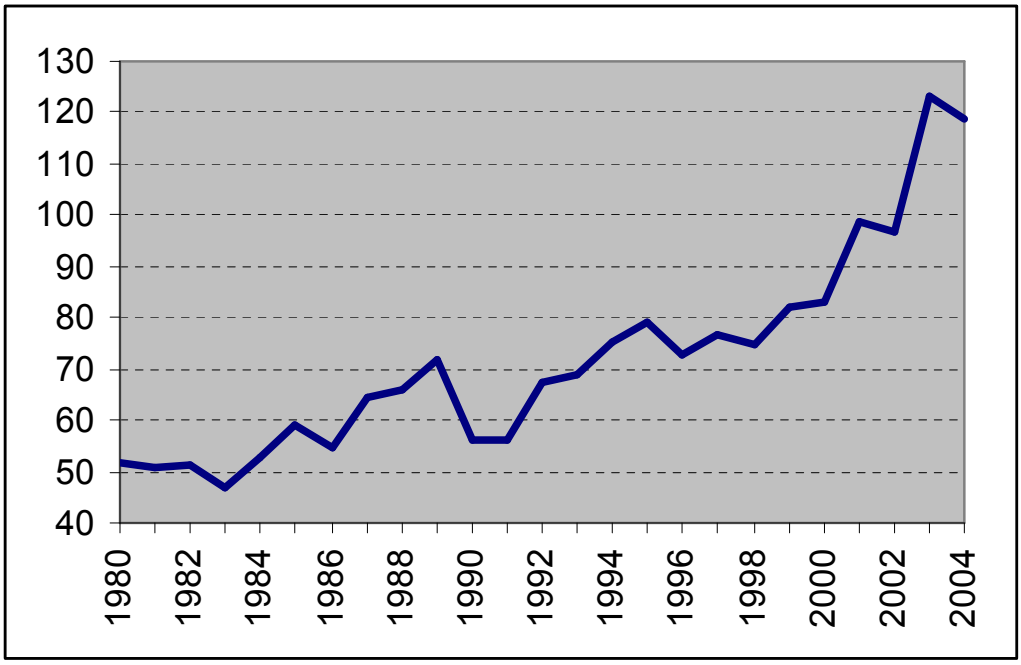
Cultivated area and wheel tractors are used here as indicators of a pattern of extensive growth. The expansion of these two elements, combined with the level of public investments in roads and an agrarian policy anticipating property rights on frontier lands - reproducing the elevated concentration of land possession of the older areas of occupation - ended up inducing large capital gains for a parcel of farmers.

It would also be expected that with the abrupt cut in inter-sector transfers of income, agricultural production would be heavily hit. What occurred in the 1980s and, particularly, throughout the 1990s, would surprise many agricultural economists. Despite the unstable macroeconomic environment and the contraction in the level of activity of the industrial sector, agricultural production continued to expand. Figure 8 illustrates the evolution of agricultural grain production in the period from 1980 to 2004. Note that total grain production has increased from 50 million tons to more than 120 million tons in 2003. The growth

is impressive after 1999: grain production increased 40 million tons in an interval of 4 years. Next section will detail the reasons for this sudden expansion.

Figure 8. Grain production evolution

(in million tons)



Source: IBGE

In summary, the main points that can be taken from this section are:

I. Beginning in the 1970´s a set of policies was implemented to modernize Brazilian agriculture. Fertilizer, agrochemicals, machinery and seed industries were built and the official rural credit system has guaranteed demand for these inputs. During the 1970´s and 1980´s Brazilian farmers started to learn how to use these modern inputs. Together with input consumption stimulus, the creation of a national research system helped to adapt modern varieties and to develop technology adapted to tropical conditions.

II. The expansion of modern input use did not reflect an increase in productivity as expected. Agricultural research takes time and only in the mid 1980´s did new varieties and techniques adapted to the cerrado areas become available. Also, taxes, price controls and rural credit subsidies distorted inputs and product prices considerably, reducing production efficiency.

III. With the macroeconomic instability of the 1980´s and the consequent government fiscal difficulties, official rural credit subsidies were suspended and the credit volume reduced considerably. There was no official credit to keep financing area expansion. Farmers answered this restriction with productivity gains. At that time (mid 1980´s) technology was ready available to raise productivity. Also, the reduction in government intervention helped to reduce the distortions created by the taxes and prices control of the previous period. It is important to notice that during the 1970´s until mid 1980´s capital accumulation was intense, increasing the stock of machinery, infrastructure, soil fertility, etc. In other words, the basis for expansion was ready for what happened during the 1990´s.

VI. Acceleration: the consequences of macroeconomic stability

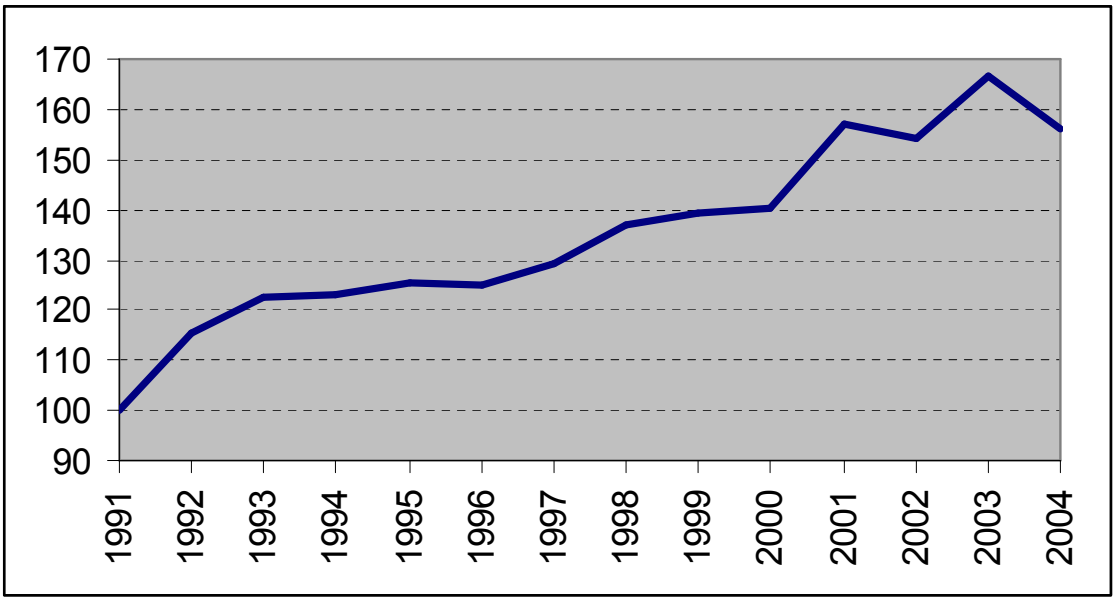
The central question from the discussion woven thus far is how was it possible for the sector to grow in such an unfavorable environment. As will be seen later , in addition to the aforementioned transformations in agricultural policy, Brazilian agriculture was the sector that first exposed itself to international competition, facing a scenario of exchange rate revaluation as of the mid-80s and, particularly, after the Real Plan.

Some elements can be examined in order to try to understand this peculiar dynamic of agriculture[7]. A first set of arguments has to do with microeconomic efficiency gains associated with significant changes in the relative prices of the factors of production. The main point to be noted is that the simultaneous movements of trade liberalization and restriction of subsidized resources ended up forcing an increase in the productive efficiency of the most capitalized firms. This pressure for increased efficiency occurred concomitantly with a favorable evolution in agricultural terms of trade (product/input), reinforcing the movement of increased productivity. Small farms with traditional technology, semi subsistence type of organization, would have been left out of this adjustment process.

Several works address the productivity gains of Brazilian agriculture in the 1980s and, mainly, in the 1990s: Bonelli and Fonseca, 1998; Dias and Bacha, 1999, Gasques and Conceição, 1998; Ávila and Evenson, 1995). Barros (1999) estimated that the gains in the total factor productivity (TFP) as of 1987 were to the order of 1.8% a year. Labor productivity increased to more elevated rates: 2.7% a year between 1986 and 1996. As can be seen in figure 9, land yield also increased from 1991 to 2004. The index constructed separated the crop component from husbandry, considering only 9 major crops. There has been a 60% increase in land productivity during the period.

[7] The articles of Dias (1988, 1989 and 1990) summarize the arguments presented here.

Figure 9. Index of productivity change for 9 major crops (1991=100)



However, the increment of land yield was not homogeneous among the main crops that make up Brazilian production. The crops presenting the highest gains of land productivity were corn, beans and soybeans. These crops are the most important in the consumption of the working class and the poorer population. Cotton showed a notable rise in yield in the period.

The products traditionally geared to the external market (cacao and coffee) did not show the same pattern of increased productive efficiency as the other crops. This can be explained somewhat by the low international prices faced for several years running. It is interesting to note that the bean crop, which is the most traditional and typical of the internal market, was the one that showed the highest increment in yield.

Part of the productivity gains presented above can be explained by a correlation with the investments in public research and extension. During the 1970s various institutions of agricultural research were created around the country (see Alves and Contini, 1992). The results obtained in these centers began to be disseminated in the growing schools of agronomy, forestry and veterinary medicine. In 1969, these courses were given in 49 units that added up to 1,008

academic places. In 1986, this number rose to 7,203 places in 96 institutions (Alves and Contini, 1992). In 1994, there were 12,142 places available in 177 different institutions (Araújo et al., 1996). A growing number of technicians linked to the sector were in good part utilized by the extension centers created by the Brazilian state in order to divulge the research and modern farming techniques. The increased investments in research and development and in the endowment of human capital linked to agriculture were part of the structural requisites to the growth of the sector (Barros, 1979).

As is well known, the returns on investment in research, mainly in agriculture, are quite slow. It is expected that there be a lag between the creation of the research centers and their results in terms of technological innovations. The same occurs with the process of diffusing the new techniques. It takes time before agents have a perfect knowledge of how the new technology works. The productivity increments coming from the use of new techniques ("learning-by-doing") only appear with time. Thus, it was unsurprising that the productivity increments would not occur vigorously in the 1970s. The returns on investments would only have an effect in the following decade. In other words, that period would have served as a basis for the growth that would follow. Even with the recession the Brazilian economy would undergo in the 80s, some foundations for growth had already been constructed.

Another important aspect for understanding the efficiency gains of the sector has to do with the weak performance of investments in the country's transportation infrastructure as of the mid-1980s. The worsening in the transportation conditions ended up forcing the intensification of the land factor, utilizing traditional areas closer to urban centers and new areas of the Center-West.

The pressure for intensification of the cultivated area was not caused solely by the lower efficiency of the transportation system. The relative prices of the factors contributed to accentuating that trend. The liberalization process of the Brazilian economy as of the mid-80s, accentuated in the Collor administration as of 1990, served to reduce substantially the prices of imported inputs.

The growing dependence on importation of fertilizers and agrochemicals pressured the liberalization of imports. The rise in imports commenced at the beginning of the 1990s, when the central government prepared a schedule of import tariff reductions. Table 14 presents the evolution of the import tariffs between 1991 and 1993. It is possible to see that the tariffs on fertilizers were practically nonexistent as of 1993. The agrochemical tariffs were around 10%. Only the sector of machinery and equipment maintained protectionist barriers of the order of 30%. In other words, with the exception of the machinery sector, it can be said that the inputs consumed by Brazilian agriculture have prices adjusted to the international market.

Table 14. Agenda of Tariff Reduction of Agricultural Products and Inputs (1991/1993)

Products	1991	1992	1993
Fertilizers	**15**	**15**	
Urea			**10**
Ammonia, sulfur			**0**
Nitrates			**0**
Super phosphate			**5-10**
Other fertilizers			**0-10**
Tractors			**30 (20)**
Equipment			**20**
Chemicals			
Raw Material			**10**
Final Products			**10**

Source: World Bank (1993)

Besides the tax reform, which fell also on the importation of agricultural products in general[8], a set of complementary reforms was implemented with the purpose of improving the system of statistical information on foreign trade and simplifying the customs control mechanisms. An agile electronic system was developed, permitting that the control of the importation process be done in a centralized and efficient manner. These mechanisms served to reduce the transaction cost of imported products.

[8] See Dias and Amaral (2000) for greater details.

The liberalization of the inputs market guaranteed a significant improvement in the terms of trade in favor of agriculture. Dias and Barros (2000) shows that between 1987 and 1998, agriculture increased its terms of trade by 30% (price of output divided by the price of input; see table 15). These gains would be much more remarkable if it was not for the animal sector. While the crops sub-sector had an increase of 46% in the prices received/prices paid ratio, husbandry suffered a reduction of 3% in this same ratio in the time period. Nevertheless, the terms of trade dropped somewhat after 1998, due to falling international commodity prices.

Table 15. **Evolution of the Terms of Trade- Product Prices /Input Prices, 1987/99 (1987=100)**

Year	Terms of Trade		
	Crops	Animal Products	Agriculture
1987	100.0	100.0	100.0
1988	118.1	92.1	109.5
1989	93.4	96.9	94.6
1990	122.0	119.6	121.2
1991	120.1	108.9	116.4
1992	121.2	102.8	115.2
1993	133.2	120.4	129.0
1994	149.4	127.5	142.2
1995	128.8	100.1	119.3
1996	122.5	90.2	111.8
1997	139.9	98.5	126.2
1998	145.7	97.7	129.9

From among the 20 products analyzed in the crops sector, almost all experienced improvement in the ratio between prices received and prices paid until the year of 2000. These significant gains allowed the sector to continue expanding the supply throughout the decade. An important point to stress, however, has to do with the form of calculating the index of prices paid. In the composition of the index are expenditures on labor, fertilizers, agrochemicals, machines, and fuel. The indicator reproduces, therefore, a technological standard that encompasses the parcel that adopts technologies that are more

advanced. Thus, though it is impossible to quantify or even identify precisely what the benefits of this improvement are in relation to exchanges, certainly those farmers that do not make use of modern inputs would not be able to appropriate such favorable relative prices; it can indeed be worse if the prices received by agricultural products fell with respect to the consumption bundle of the small farmer household.

Ferreira Filho (1997) shows that the reduction in the prices of factors of production made possible a significant reduction in the average costs of several crops. From a series of production costs gathered by the Institute of Agricultural Economics of the State of São Paulo (IEA) from 1980 to 1994, the author studies the behavior of said costs for corn, rice, beans, cotton, manioc, soybeans, and wheat. The reduction of the costs per unit of output is very clear in the period. From an index of 100 in 1981, in 1994 it reaches a value of 44 for cotton, 43 for rice, 22 for beans, 37 for corn, 59 for manioc, and 57 for soybeans. In other words, there was a drop of more than 50% in production costs. For the majority of products there was driven basically by the reduction of input prices as a consequence of import tax reduction. Also, it must be said that to some extent, technological advances helped to reduce unit costs.

As mentioned, the main cause pinpointed for the reduction of production costs was the drop in the prices of factors. As Homem de Melo (1992) states, in the 1980s there was a drop in the prices of fertilizers, agrochemicals, and fuel. Only the prices of agricultural machinery showed a rising trend. However, parallel to the reduction in the price of the factors there was a drop in the prices of almost every agricultural product until 1998. It would be worth knowing, therefore, whether the drop in prices of the products would be enough to more than compensate the reductions in average costs.

Table 16, extracted from Ferreira Filho (1997, page 11), calculates the ratio between the prices received and the indices of unit cost. One can observe that despite the downward variations in some years, there is a rising trend in the prices received/unit cost ratio, indicating improvement in the economic situation

of farmers. The series clearly shows that the margin, at the level of farm properties, increased systematically in the period. The only exception is the manioc crop, which faced a systematic reduction in its margins.

Table 16. Index of the ratio product price/unit cost of production. (1981=100)

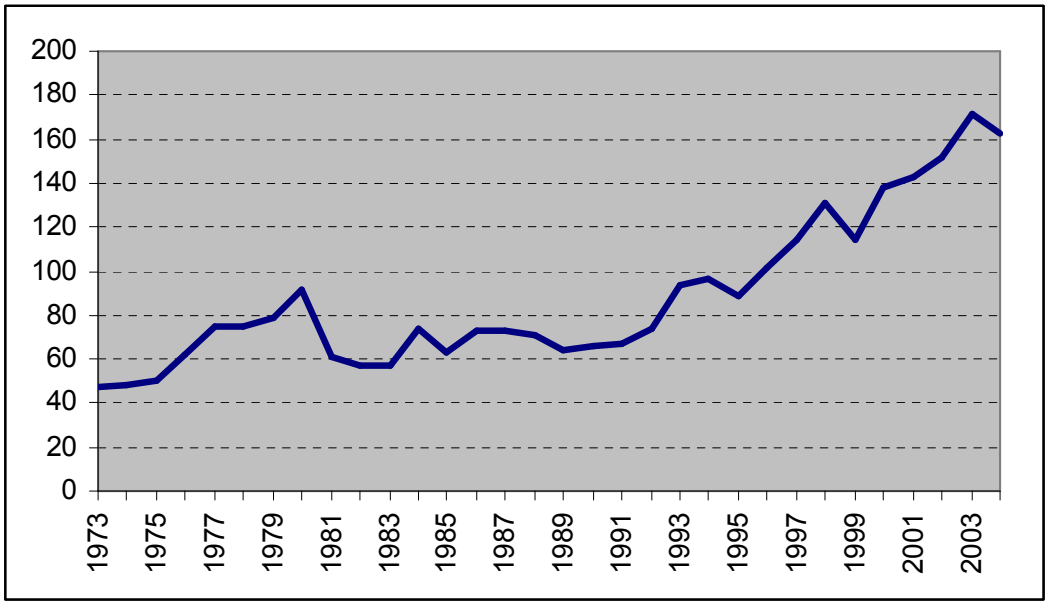
Year	Cotton	Rice	Beans	Corn	Manioc	Soy
1980	137	177	123	130	147	179
1981	100	100	100	100	100	100
1982	102	135	59	98	58	94
1983	94	147	86	136	72	110
1984	108	127	108	121	99	119
1985	119	186	37	141	101	110
1986	110	121	73	172	40	147
1987	86	71	122	64	22	111
1988	96	80	81	99	101	78
1989	47	59	122	81	56	59
1990	57	84	86	82	21	49
1991	61	122	144	114	19	78
1992	82	107	138	142	47	94
1993	148	172	252	204	75	125
1994	108	112	216	114	46	86

Source: Ferreira Filho (1997*)*

The relative cheapening of fertilizers radically altered the path of growth of Brazilian agriculture. Throughout the sequence of heterodox plans for economic stabilization launched during the 1980s and 1990s, land prices oscillated quite a bit but, in general, were relatively high. As various studies developed over the last few years attest, land came to serve as a value reserve against the successive shocks the Brazilian economy suffered. This fact ended up inflating the value of land, favoring its intensification.

The “biological route” of Brazilian agriculture can be appreciated through the inspection of figure 10. The graph shows the quantity of nutrients (NPK) consumed per hectare in Brazil from 1973 to 2004 (kilogram per hectare). The intensification in the use of chemical fertilizers becomes clear: in 2004, it reaches the level of 170 kilogram of nutrient per hectare. According to the data from FAO (FAOSTAT), this amount is similar to the United States.

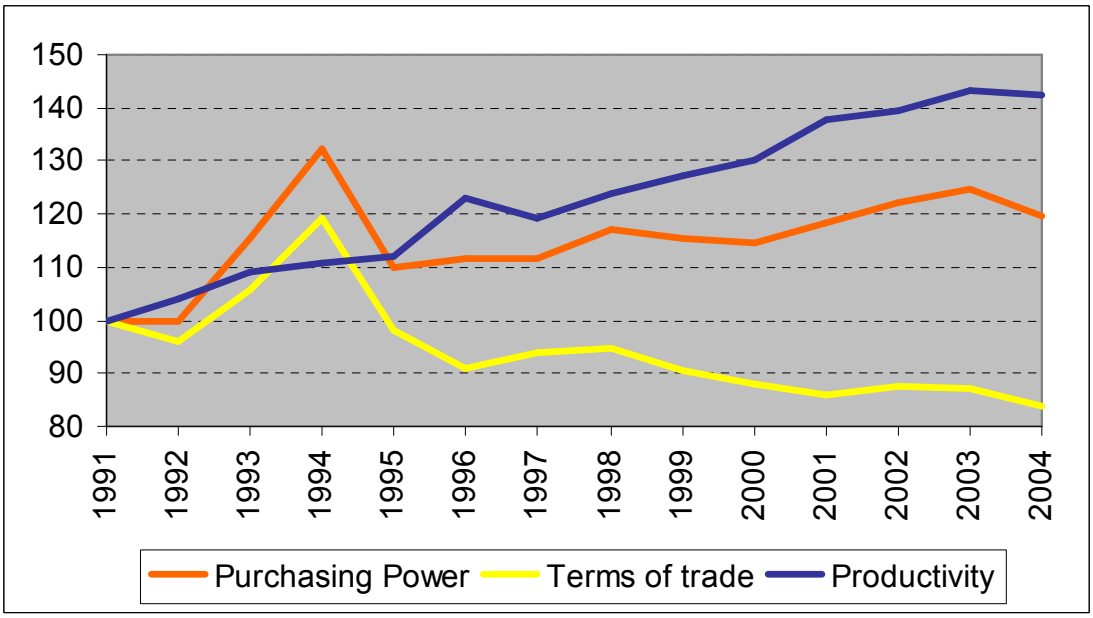
Figure 10 . Fertilizer per hectare (in kilogram/hectare)



From the information above, it is now possible to prepare an explanation for the good aggregate performance of the sector even under such adverse macroeconomic conditions. The joint increase of productivity and terms of trade of the sector guaranteed a notable rise in the purchasing power of agriculture. Figures 11 and 12 illustrate this argument well. An indicator of the profitability of the activity (purchasing power) was constructed, which is composed of the combination of the productivity gains and the evolution of the terms of trade (purchasing power is the productivity index times the terms of trade index). Elevations in the terms of trade (prices of output divided by prices of inputs) and/or in the productivity of the firms guarantee an increase in profitability.

As can be seen in figure 11, there has been an increase in purchasing power of the agricultural sector expanded during the period considered. There has been a gain of approximately 40% between 1991 and 2004.

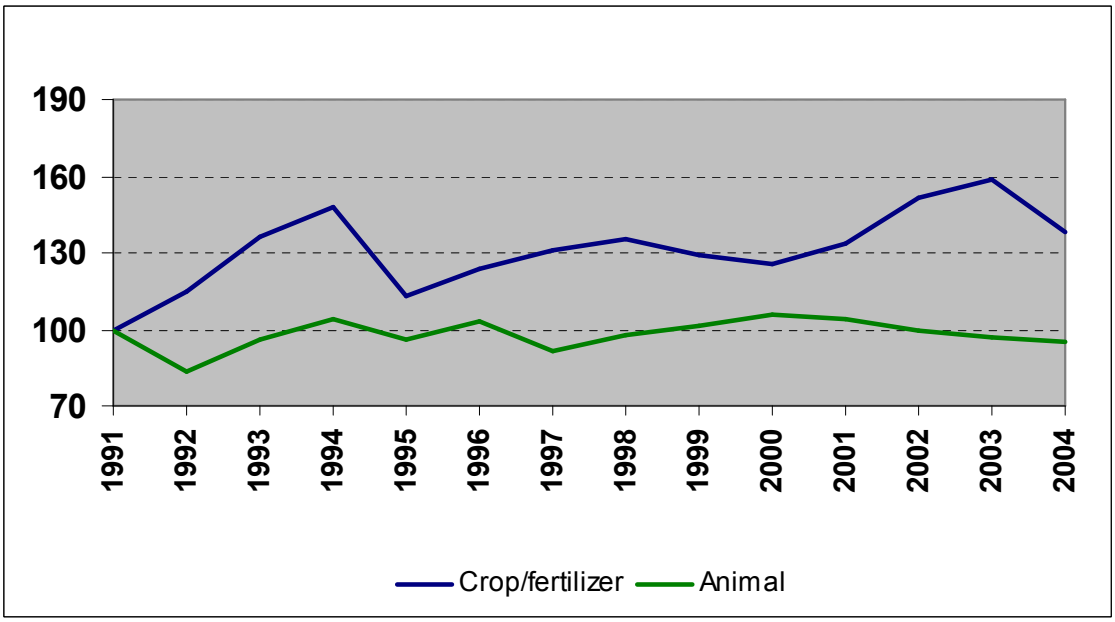
Figure 11 . Index agricultural (animal and crops) terms of trade, productivity and purchasing power (1991=100)



The sector of crops showed a much more vigorous performance in the period considered. As seen in Figure 12, the purchasing power of crop considering the price of fertilizer grew 60% between 1991 and 2003, dropping strongly in 2004 as a consequence of escalating international fertilizer prices. The animal sector, however, has shown no increase in its purchasing power during the same period. This pattern can be explained by the large dependence of the internal market demand that has not increased much as a consequence of small economic growth. Only after 1999 did the share of exports in total domestic production increase[9], indicating that in the medium term, relative prices should change production in the Brazilian agribusiness system.

[9] Chicken export is an exception.

Figure 12. Index of animal sector purchasing power and crop sector purchasing power (1991=100)



This advantage, measured in terms of productivity and improvement in exchange ratios, is what allows the high-technology farmer to find substitute financing for the traditional system of rural credit. The gain in purchasing power that was a consequence of better relative prices together with productivity gain, allowed producers to increase profitability. This was the way that producers found for financing production, compensating the financial restriction imposed by the reduction in the fiscal capacity of the state, generated a rather dynamic autonomous system. It is certain that the returns on agricultural activity do not allow a very high rate of growth. However, the pattern of increase of the internal supply was enough to meet the expansion of internal demand at falling prices. It is important to observe that, in this new system, all the producers with below average productivity are undoubtedly undergoing a process of decapitalization and gradually exiting the industry.

The self-financing does not completely explain how it was possible to finance the growth of agriculture throughout its process of structural change. The transformations in the structures of food commercialization should also be taken

into consideration. The financial restrictions of the public sector, as previously discussed, forced a progressive reduction in the minimum price and regulating stock mechanisms. The entry of the private sector was making up for the withdrawal of the state from financing and commercialization of production. The food processing industries, the traders, and the supermarkets began to develop a sophisticated informal system of production financing. The logic behind this movement has to do with the ability of these segments to gather capital in a macroeconomic environment marked by instability and high interest rates. Part of the food industry and all of the exporters began to gather resources abroad, transferring these resources to producers integrated to their productive chain. In the case of the food industry, not only the funds to finance production, but also all the genetic material and the production technology began to be furnished to the producers. This link constructed over the period constituted an additional explanation for the referred productivity gains of Brazilian agriculture, in particular, of small animal husbandry.

Without Cargill, Bunge and ConAgra t Brazil would not be where it is today. But there is no data on the total capital that those firms invested during the last decade.

The supermarkets, for their part, guarantee significant gains in the period of high inflation rates, resulting from cash sales and post-dated sales. This capitalization made possible a rapid expansion and concentration of the retail sector, altering the relationships with food suppliers, especially vegetable and fruit producers. Again, this process of transformation in the structure of production financing reinforces the discrimination in favor of those more technologically advanced producers, because the standards of quality imposed by the private sector require technologies that are more sophisticated. In other words, the alteration in the commercialization system ends up favoring the gains in scale and the standardization of production.

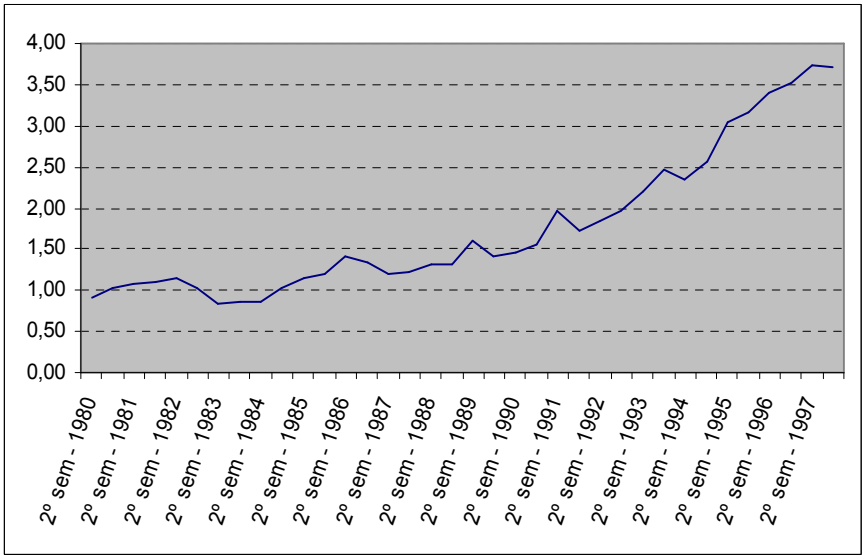
The reduction in food prices did not occur merely because of the increased internal efficiency of some producers. The process of market liberalization

initiated in the mid-1980s, intensified as of 1990, imposed a new pattern of internal food prices. In particular, the integration of MERCOSUR altered the ratio between the prices received by the farmers and the prices paid by the urban wage-earner[10].

The reduction in the margin of commercialization of the sector was compensated, somewhat, by the elevation in the internal demand for food. This fact constitutes an additional explanation for the performance of agriculture in the period in analysis. The expansion in the purchasing power of the real salary, provided by the reduction in the relative price of food, guaranteed a growing demand throughout the period. To give shape to the real salary gains of laborers, Dias and Amaral (1999) calculated the ratio between the nominal salary in civil construction and food prices (taking the food and clothing component of the Consumer Price Index, FIPE). The salary in civil construction was utilized because it is the most flexible in the economy, in addition to reflecting the least skilled parcel of laborers. The result can be seen in figure 12. One can see that, the gains in real salary of the laborers were quite substantial, mainly as of the economic opening of the 1990s.

[10] See Dias and Amaral (1999) for a more thorough analysis of this issue.

Figure 13. Evolution of the Purchasing Power over Food of the Civil Construction Salary

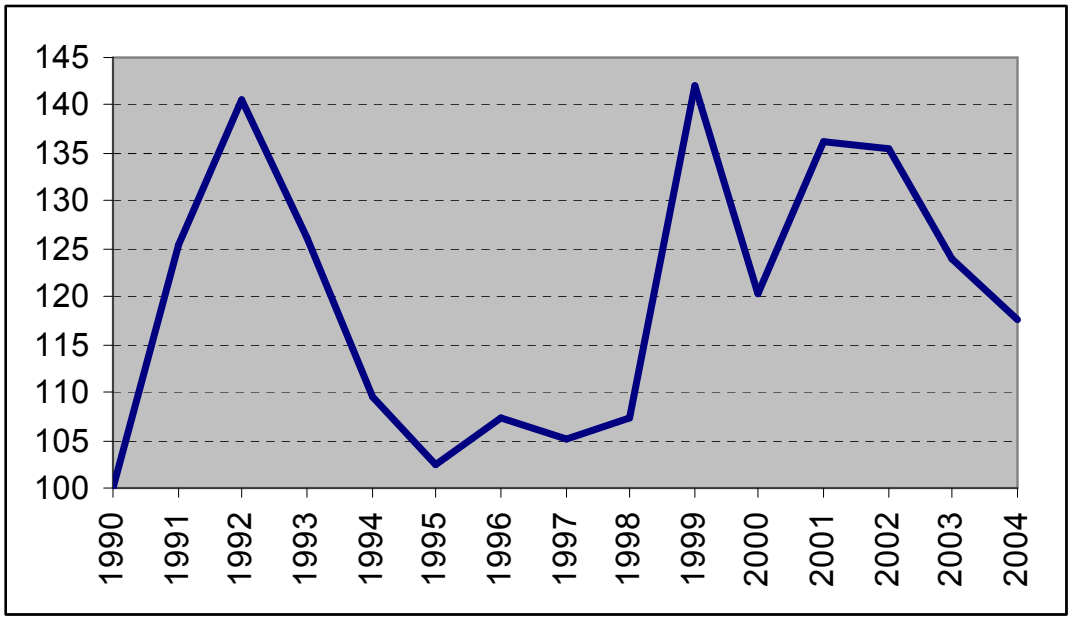


Source: Dias and Amaral (1999)

The analysis done so far indicates that relative prices (terms of trade) due to reduction in input prices had induced intensification in production, mainly as a result of opening the economy in the beginning of the 1990s. Also important to intensification was the previous development of new technology, the increase in productivity due to gains derived from “learning by doing”, the gains in efficiency due the learning process of optimizing the use of inputs. In summary, the production system was ready to grow fast. What was missing was a stronger economic stimulus.

Although the real income gain that consumers had in 1994 with the end of inflation had a strong impact on consumption, domestic agricultural prices were kept down by the overvalued currency. That overvaluation was an essential part of the stabilization strategy: the idea was to end inflation trough the control of tradable prices, keeping it low through an overvalued exchange rate. Figure 14 presents an index of the real exchange rate, indicating the magnitude of the valuation of the currency implemented at the beginning of the Real Plan (1994).

Figure 14. Index of real exchange rate (R$/US$, 1990=100)



Souce: BACEN

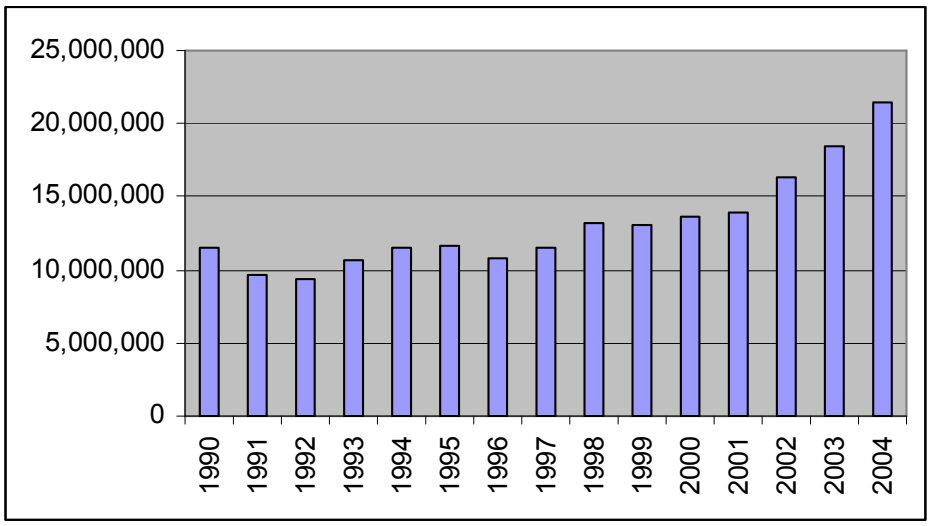
It would take us far from our main subject explaining the history of the Real Plan; the important point to notice is that at the end of 1998 the currency devalued fast, forcing tradable prices up. This was the stimulus that was missing to accelerate growth.

A coincidence, however, helped to strengthen the favorable exchange rate. Soybean prices started to increase sharply, part as a consequence of the mad cow disease: demand for vegetable protein in substitution to animal protein in animal feed increased in Europe. This sudden change in relative prices guaranteed by the exchange rate together with an opportunity in the soybean market started the expansion in production.

Figures 15 and 16 presents, respectively, the levels of soybean area and production between 1990 and 2004. Note that both area and production has increased after 1999, changing from a level of 14 million hectares to 22 million in 2004. Production had not increased by the same rate mainly because of productivity problems. The 2004 harvest suffered from weather and disease

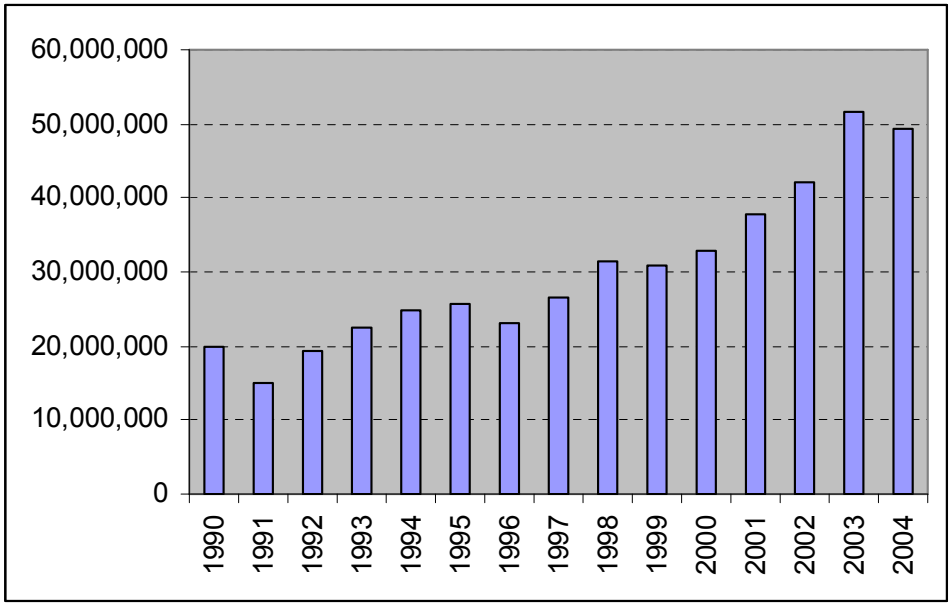
(rust). A normal productivity level would have guaranteed a production around 60 million tons.

Figure 15. Brazilian soybean area, 1990-2004
(in hectares)



Source: IBGE

Figure 16. Brazilian soybean production, 1990-2004
(tons)



Source: IBGE

This rapid increase in grain production, spearheaded by soybeans[11], was only possible because of the presence of global traders and multinationals in the agrichemicals sector. Bunge, Cargill, ADM, Dreyfus, Basf, Bayer, FMC, Syngenta and Monsanto were all present in the country. They became fundamental in financing Brazilian agriculture. As noted previously, a consequence of federal government fiscal difficulties was the reduction in rural official credit relative to agricultural needs. There are some estimates that indicate that the formal credit is enough to cover only a fourth to a third of the credit necessary for a Brazilian harvest. The other part of the financial needs comes from the private sector and farmer's own capital. An informal credit market was developed during the middle of the 1980s and mainly after the middle of the 90s between traders and farmers. There are some contracts of pre-commercialization: when farmers are planting (September), traders anticipate capital to the farmer (many times with fertilizer) so as he or she can cultivate; farmers gives in exchange his future production (harvested in March).

To give a dimension of this system, Bunge and Cargill started relationships with many Brazilian fertilizer firms with the objective of simultaneously having a product to trade with (grain) and to reduces its transport costs (the same truck that carries soybeans to the port brings fertilizer back) and fixed costs (present in their storage structure). Today Bunge and Cargill are responsible for more than 60% of the fertilizer market[12]. This informal credit system explains how Brazilian agriculture could grow despite of official credit restrictions. It also shows Brazil's importance in the strategy of global traders: buying Brazilian (and Argentinean) soybeans when the United States and Canada are harvesting (September) guarantee supply for next March, lowering considerably the volume of stocks needed to supply different countries in the world.

In summary, the main aspects to be taken from this section are:

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[11] Soybean is the most important crop in Brazilian agriculture. To give a dimension of its importance, soybean is responsible for more than 40% of Brazilian fertilize consumption, which is the 5th largest market in the world.

[12] This is a raw estimate based on potash import (almost 100% of Brazilian potash consumption is imported).

I. The opening to trade at the beginning of the1990´s lowered input prices and raised export prices in the Brazilian agricultural sector. The benefit in relative prices induced farmers to intensify production, raising productivity and lowering unit cost of production (cost per unit of product). These movements raised the profitability of agricultural production. Profits were important to explain how agriculture expands despite the strong reduction of the official credit system.

II. Openness to trade helped multinationals traders to expand its participation on Brazilian agriculture. These companies start to play a definite role on Brazilian agriculture. Part of the credit needed to expansion came from these multinationals: the access to low capital cost allows traders to lend money to farmers finance production in a very profitable way. These movements also compensated the reduction on public sector finance participation. It is important to notice that Brazilian agriculture is basically a private one, that is, public presence is very low (credit, subsidies, taxes, etc).

III. It is important to notice that multinationals assure a pattern of quality and worldwide access to markets that makes Brazilian agricultural products feasible to reach any country in the world. In this sense, Brazil is a important supplier in the strategy of these multinationals.

IV. The presence on international markets is guaranteed by its low costs of production. The intensification process that marked Brazilian agriculture induced high production efficiency in a ample variety of products. In many markets Brazil have one of the lowest costs of production in the world.

V. Although Brazilian agriculture is still much smaller than American, much land is available for expansion of production. This possibility together with the high technological standards allows one to conclude that Brazilian participation on international markets will keep increasing.

VII. Strengths, weaknesses and challenges

After three decades of change, it seems now that Brazilian agriculture is beginning to shape a unique agricultural model: modern, technological intensive and tropical. It is not easy to foresee all aspects of this model still growing, but it is possible to point out its main strengths, weaknesses and challenges.

Strengths

Inexpensive and abundant land

Brazil still has an impressive amount of available land. There are some different studies on land availability but they tend to converge to figures like 100 to 200 million hectares depending on environmental concerns (including or not part of the tropical forest region). Also there is a huge area of pasture land that is characterized by low productivity and that is now becoming integrated into crop production. As noted before, total pastureland area is around 180 million hectares. To put it into context, all Brazilian agricultural harvested area (considering only crops) is around 60 million hectares. These figures show that there is room for expansion.

Technology

The most important technology developed during the last decades was the no tillage plantation system. This system was definitive in the technological conquest of the “cerrado” area. Tropical weather demands soil protection and the traditional system and its machinery proved not suitable for such a climate. Together with plant nutrition and genetic development, the new system proved to be highly productive.

Double cropping

Thanks to no tillage practices it turned out to be possible to do double cropping in a single year with little risk. This assertion is mainly true to Mato Grosso and parts of Goiás; Paraná State, although located in the south, has always

developed a double cropping system thanks to its excellent rainfall distribution[13]. No tillage reduces the time expended on mechanization, allowing double cropping with low weather risk.

Crop-cattle integration system

A growing system of production that has been developed during the last decade is the so called crop-cattle integration system. There are some variations on the types of integration but the general principal is the rotation of pasture with crops. The no tillage system demands straw to protect the soil. At the end of the rain season, farmers traditionally planted a crop only for soil cover. Grass can be used for that purpose, and it makes for very good soil protection. Also, with crop rotation, soil fertility improves and pasture productivity rises considerably. With the close presence of agriculture, several by products of processing plants can be used to feed cattle in a very economical way, elevating animal productivity. It is interesting to note the presence of feedlots all over the cerrado area, a technology that a few years ago was infeasible in many regions. As will be noted, the rotation is fundamental to the sustainability of agricultural production, especially under tropical conditions.

Scale

The modern production system of the cerrado is concentrated. Because of capital scarcity in Brazil, and also, because of relatively historical labor scarcity in the central region (the frontier), relative prices of inputs (land and labor) has induced mechanization, in a route similar to the United States. Farmers are now becoming firms with structures to store, and some, to transport their own production. Plain relief, large farms and good weather allows some gains form economics of scale.

[13] The tillage system was first developed by farmers from Paraná, in the middle of the 70s. After first experiences this technology was transferred and adapted to the cerrado area.

Low weather risk at the cerrado area

As mentioned earlier, parts of the Brazilian central area are characterized by low weather risk. This element turns out to be essential in the informal financial system developed between farmers and traders/input firms (mainly chemicals and fertilizers). Many farmers at the cerrado need capital from traders to finance production. Traders have to rely on some contracts that normally guarantee some protection from bad conduct but there's no protection to productivity risk. There's no agricultural insurance system in Brazil; so, low weather risk is essential to develop a sound finance private system. It is interesting to note that our interviews suggest that at Mato Grosso almost 60 to 70 % of soybean production is sold in September, when plantation begins. In the south, especially at Rio Grande do Sul, where weather risks are high, pre-commercialization is around 10 to 20 %.

Research

The Brazilian agricultural system has depended on and will continue to depend heavily in its research system. The federal research system leaded by EMBRAPA has a presence all over the country, doing research for different weather conditions and for different products. There are some states research systems, especially in São Paulo, that have some regional impacts. Also, many private research foundations have been created by farmers to study plant nutrition and mostly to develop new genetic material. There are a large number of private firms that are developing new genetic material, new techniques of mechanization and pulverization, plant nutrition and so on. The majority of the larges multinationals of the input sector has a long presence in the country.

Human capital

During the last decades several schools of agronomy, veterinary, zootechny, and biology have been created in Brazil, spreading all over the country with a considerable number of well trained professionals. A proportional number of graduate programs were found, increasing the quality of those professionals. Today, the Ministry of Education requires universities with a minimum

qualification for teachers and researchers. The majority of public universities and a growing part of the private system have a large participation of professionals with Doctors and Masters Degrees. A part of these researchers have received international qualification, in different programs of a PhD or fellowships.

The professionals working with agriculture are every where: in farms, private firms of the agro-chain, consulting firms, cooperatives, etc. It is interesting to note that the majority of modern farms have consultants for many different aspects of production: nutrition, pulverization, mechanization, characterizing a specialization that is responsible for productivity increases. Also, it is important to mention that all input firms have a group of professionals to assist in the spread of technology. This was previously done by the state (in the 1960s and 70s); with the fiscal constraint of the 1980s and 90s, private firms have taken the course of the process as a marketing strategy. Many meetings and workshops on technical matters are organized by firms and cooperatives.

Product diversification

One aspect that is interesting in Brazilian agribusiness is the large number of products with a complete chain of production. Sugar and alcohol, oranges, coffee, soybeans, cotton, wood, tobacco, rubber, cocoa, fruits, tomatoes, red meat, chicken, eggs, milk, pork and minor chains such as flowers and vegetables are all present in the country. This diversification guarantees some stability do the system as a whole in the sense that considering that price variation is the rule in commodities markets; a diverse production system assures more stability.

Sophisticated and internationalized agribusiness system

During the last decades, the quality and control of production and processes has improved systematically. This movement was a consequence of the increasing quality of the processing industries, the sophistication of the super-markets, the increasing consumer demand for quality, and the introduction of information technology. These movements suggests that traceability and certification in the majority of Brazilian commodities and products is something not far away, as can be seen in the diversity of products available today. Also, the presence of the

largest multinationals of the agribusiness sector in Brazil constitutes an element of strong advantage. Multinational quality pattern guaranties access to markets with all kinds of product quality standards. This aspect is extremely relevant for international trade.

Weaknesses

Agronomical difficulties

The fast growth in production of last 5 years has shown the difficulties ahead in terms of agronomical issues. The sudden increase in soybean area, together with no rotation as a consequence of good soybean prices, spread a number of diseases that hurt producers. The rust dissemination during the harvest 2003/2004 was very extensive. Rust first appeared in Bahia; the next season it was all over the country, from north to south. In tropical conditions there is no cold winter to stop diseases from developing. That is a major restriction under tropical conditions. It is important to notice that as production grows, problems will not necessarily appear in a linear way. Growth will imply a required great effort in developing new production practices, crop rotations, new genetic material, in short, new technologies. Research will still be the key for success. It is impressive to realize that keeping things in historical perspective, the dynamic process described so far in terms of rapid expansion in output is just the beginning.

Transport infrastructure

A major problem for the central region production is freight prices. Logistics reduces the profitability of agriculture because of higher prices for inputs and lower prices for output. The majority of Brazilian production is transported by truck. Railroads are rare and with several problems of integration (because of different gauges), and speed (railroads cross many towns). The largest part of soybean and cotton production in Mato Grosso for instance is exported through Santos (São Paulo State) and Paranaguá (Paraná) all done by highways. With the sudden increase in soybean production, highways are always congested and

in bad condition. Highway, railroad and ports are presented in the maps in the appendix.

There have been some new investments in roads and highways to open an access to the north of the country, which will decrease freight cost to a third, according to interviews with private traders that are operating in Mato Grosso. Hydroelectric power is also being developed, allowing access to the Amazon River. It is relevant to note that environmental restrictions will always retard the process of infrastructure expansion.

Environmental concerns

The expansion of Brazilian agriculture has now reached the Amazon Region. Although there are laws restricting deforestation, they are not being respected. The economic stimulus of the last 5 years resulted in an amplification of the deforestation process. There is a clear conflict of interests between the environment and agriculture. A new highway is excellent for agriculture (and industry) but the economic expansion that follows from the new roads is bad for the forest. It is not clear which force will succeed, but one thing is becoming clear, changes in infra structure will be slower than previously believed. Brazilian society is now urban (more than 80% of the total population live in towns), and naturally more sensitive to environmental degradation.

Import fertilizer dependence

As shown before, Brazilian agriculture depends heavily on fertilizers due to the naturally low fertility of its soils. Today almost half of nitrogen and phosphorus is imported; almost 100% of potash consumption is imported. There is room to expand production of nitrogen as a consequence of new discoveries of natural gas reserves. There is also room for expansion in phosphorus production (which is already occurring), but there's no condition of expanding potash production because of the inexistence of good reserves (there's only a very small one in the northeast). **This dependence indicates that Brazil will need a strategic partner to keep trading as is the case of Canada**.

Phyto-Sanitary risks

The increase in the size of the Brazilian agribusiness will elevate sanitary risks as mentioned. Also, the growth in international trade brings together the risk of contamination with diseases that exist abroad. In other words, the probability of sanitary problems increases with more international integration.

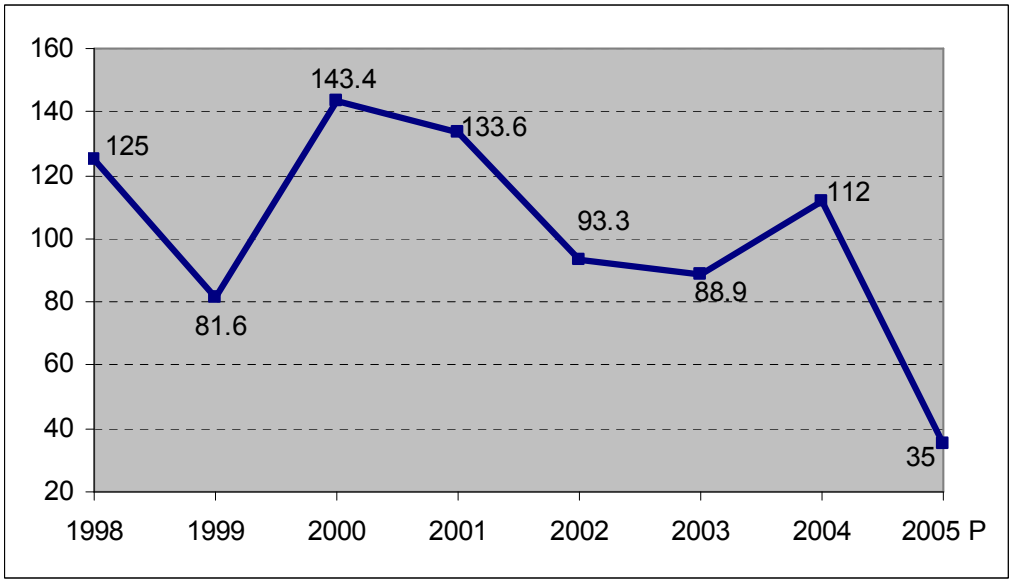
Brazilian exports have an interesting characteristic in that it involves a large number of countries. For instance, red meat exports go to more then 150 different countries. This ample number of partners, although diminishes the risk of a sudden reduction in exports, imposes a difficult administration process to private firms. Our interviews indicated that the commercial structure of exporters has to deal with a vast amount of phyto sanitary legislation that each country has. There is a positive aspect of this complex system: firms are improving product quality control and traceability. But, at the same time, it is costly to deal with such a variety of specifications and restrictions.

The Central Government is trying to organize legislation and is building a structure to deal with international patterns of quality and safety legislation. But financial restrictions do not indicate that public policy will accompany the speed of private needs for export expansion.

Budget constraints are imposing cuts on the Ministry of Agriculture resources for safety controls. Brazilian federal government debt is restricting expenses and due to political constraints, cuts in expenses are generalized to all parts of the government. Is hard to choose and establish priorities among different Ministries.

Because of that, despite the growing exports in the agribusiness sector (and the consequent need of sanitary controls), resources allocated to food safety is falling every year. Figure 17 presents the federal sanitary defense budget between 1998 and 2005 (provisional). One observes that resources are diminishing and this year's budget is much smaller, although it may recover due to private pressure. Care should be taken because there are many state systems that control the process, which mitigates the impact of the federal restrictions.

Figure 17. Federal sanitary defense budget (million R$)



Source: Ministry of Agriculture (2005)

Small farms

The modernization of Brazilian agriculture was marked by a dichotomy between capital intensive/large scale farmers and the small farm sector. Pressed by product price reduction, high capital cost, and sophistication of new technology not feasible for small scale, this segment of farm had a growing difficulty to survive. It is not clear what the solutions are to this sector for Brazilian agriculture.

Challenges

All the weaknesses presented above indicate what the major challenges are. However, two special topics deserve attention. First, there is a need to improve financial markets. The official credit system is too small for production requirements. According to our estimates, official rural credit resources is sufficient for something around 25 to 30% of total capital requirement. The other part of resources are the own farmer resources (around 35% of capital needs),

and the ones that comes through traders and input firms, which in many cases are the same.[14]

The informal financial system developed in Brazilian agriculture is expensive for farmers. Because of high opportunity costs (nominal basic interest rate is currently at 19.6% a year, with a 7% inflation projection) banks do not have an incentive in lending money to farmers. The low supply of funds by the financial system leaves only the private firms (traders, agrochemicals) as a source of resources.

Informal credit arrangements lead to judicial problems. Last year, when soybean prices went up to US$ 10 per bushel, some traders had trouble in receiving the soybeans bought previously, when the market prices were much lower. This fact was the first large scale stress to the informal credit system developed during the last decade.

The financial model of Brazilian agriculture has to also develop insurance markets. Although productivity risks are low in parts of Mato Grosso, Gioás, Paraná, this is not true for a large part of the country. This season drought has severely affected the south of Brazil.

Another major challenge to public and private sectors is the development of a capacity to reduce trade barriers in the rest of the world. There are several barriers to trade that Brazilian agriculture suffers and that are being contested. Also, the safety regulations all over the world are varied and complex which calls for harmonization of principles and procedures. New international institutions or agreements have to be built so as to deal properly with such matters.

[14] These figures constitutes raw estimates; there are no data on informal credit.

VIII. Implications

There are some implications for Canada, taking into account all of the trends and developments described in this report. The major topics that deserve attention are:

There are trade opportunities to Canada due to some complementarities in the trade balance. Brazil has some typical tropical products such as coffee and fruits. Canada has a comparative advantage in wheat production that is already the major product imported by Brazil.

Due to its dependence on fertilizer and especially considering no Potash mines in Brazil, a global supplier of this nutrient is strategic to Brazilian agriculture.

Another important point is technology. Multi-national firms in the input sector (fertilizer, agrichemicals, machinery) play a definite position in the future of Brazilian agriculture. The need to adapt technology to tropical conditions requires their presence in the country, but the major developments are all done at the headquarters. Also, it is possible to suppose that in the medium to long run, technologies adapted to the tropics could be exported to other countries.

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X. Appendix

Chart A.1. Brazilian map

BRAZIL - RAIL ROADS

BRAZIL - MEAN WATERWAYS AND PORTS

BRAZIL - HIGHWAYS